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Contents

EFFECT OF CYTOKININ PRECONDITIONING ON *IN-VITRO* MULTIPLE SHOOT REGENERATION OF LENTIL CULTIVAR

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Abstract: This study was aimed to establish a protocol for enhancing shoot proliferation, rooting percentage during the regeneration of lentil cultivar and also to demonstrate that pre-culturing of seedlings stimulates production of multiple shoots from cotyledonary nodes and shoot tips of Lentil cultivar. The highest direct shoot regeneration (79%) with an average of 15-16 shoots/explant were obtained when cotyledonary node explants were excised from seedlings germinated on Murashige and Skoog modified (MSM) media supplemented with benzyl adenine (BAP) 5 mg l^{-1}, and subsequently cultured on MS modified media with 0.5 mgl^{-1} benzyl adenine (BAP) . Pre-culturing of seedlings, at the time of seed germination with high BAP concentration results in fast and multiple shoot regeneration followed by culturing the explants on lower concentration of BAP. For rooting, different concentration of IBA, IAA and NAA were used and highest rooting was recorded on half strength MS medium supplemented with 0.3mg l^{-1} IBA. The rooted plantlets were hardened initially in culture room at 27±2°C and then transferred to *in-vivo* environment. The highly regenerative system developed in the present investigation for this important legume crop could be a useful tool for genetic transformation.

Keywords: Cotyledonary node, *In vitro*, Lentil L-4076, Multiple shoots, Roots regeneration

INTRODUCTION

Lentil is a good source of cholesterol-lowering fiber edible pulse and an essential source of inexpensive protein in many parts of the world, especially in West Asia and the Indian subcontinent, which have large vegetarian populations. Lentils also help in managing blood-sugar disorders since their high fiber content prevents blood sugar levels from rising rapidly after a meal. The low levels (5%) of Readily Digestible Starch (RDS) and high levels (30%) of Slowly Digested Starch (SDS) make lentils of great interest to people with diabetes. Lentil is often a preferred crop in the water deficient areas because of its drought tolerant nature.

Lentil (*Lens culinaris* Medik.) is the third important cold-season food legume, after pea and chickpea grown all over the world in 4.2 million hectare area with yield of 1083Kg/Ha (FAOSTAT 2012), for its high nutritional value (20-36 % protein). Pulse crops, such as lentils, have long been considered to be recalcitrant to cell and tissue culture and are among the most difficult legumes from which to regenerate whole plants due to problems of root induction. The frequency of root formation in lentil is dependent on cultivar and growing medium with supplements. On MS Modified medium, indirect regeneration of lentil was found (Bagheri *et al.*, 2012).

Direct regeneration and multiple shoot formation have been achieved from intact seedling cultures, shoot tips, the first node, and the first pair of leaves in media supplemented with BAP and NAA (Malik & Saxsena 1992; Bajaj & Dhanju 1979; Singh & Raghuvanshi 1989; Khanam 1994; Polanco *et al.*, 1988 and Sarker *et al.*, 2003). Prolific adventitious shoots after the initial callus stage from cotyledonary node using TDZ is reported in lentil (Khawar *et al.*, 2004). Pre-culturing of seedlings with high dose of cytokinins has been reported to improve subsequent regeneration efficiency in various plants, including grain legumes (Gurel *et al.,* 2011; Amutha *et al.*, 2006). Similar results were achieved by (Muhammed *et al.*, 2013) from plumular apices of chickpea using seeds preconditioned with 10mg/l BAP for 10 days on MS medium.

(Khentry *et al.*, 2014) also conducted *in vitro* propagation for six genotypes of lentil (*Lens culinaris* ssp.) Mature seeds were initially cultured on Murashige and Skoog (MS) medium supplemented with 4 mg/1 of benzyladenine (BA). The maximum number of shoots per seed was 4.13+0.33. (Fethi *et al.*, 2014) aimed to develop efficient and reliable protocol for in vitro plant regeneration. Shoot tip, stem, hypocotyl, cotyledon and root as used as explants. The MS medium containing 4 mg/l BAP induced maximum number (8.25) of shoots per shoot tip explant. However, IBA derived shoots were easy to root on MS medium containing 1.87 mg/l NAA but still the rooting percentage is quite low.

The rooting of *in vitro* regenerated shoots present problems in achieving whole plant regeneration systems and there are contradictory reports for rooting in this plant. (Polanco *et al* 1988), used MS medium supplemented with NAA for rooting but the frequency of rooting was low. Similar results were reported by (Khawar and Ozcan 2004), on MS medium containing 0.25 mg l^{-1} IBA, showed root induction with frequency of about 25%. (Tavallaie *et al.*, 2011) evaluated Lentil regeneration by using explants including leaflets, stems, and cotyledons with and without embryo axis. Cotyledon with small part of the embryo axis was the superior explant.

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Over 40% of the elongated shoots produced roots in solid 1/4 BS media with 50 µM NAA for 3 days followed by 10 days in a mixture of liquid 1/4 BS, Vermiculite and sand. (Muhammad Aasim 2012) transferred regenerated shoots grown on MS medium containing 0.25 mg/l BAP on MS medium containing 0.25 to 1 mg/l IBA and IAA. The frequency of rooting was unsatisfactory. (Khentry *et al.,* 2014) reported that no root formation was observed on any of the six genotypes cultured on MS medium without the addition of NAA. Two varieties show little response to NAA, with roots formed from single nodes grown on a concentration of 1 mg/l. In rest of the plant unusual root and callus structures were reported. Thus, in this study, an efficient and reproducible protocol was developed for *in vitro* multiple shoot regeneration and rooting of explants in different concentration of cytokinins and Auxins.

MATERIAL AND METHOD

Lentil seeds (L-4076) obtained from IARI, Pulse Laboratory, PUSA, New Delhi. The seeds were surface-sterilized with 70% ethanol for 2 min followed by 0.2% (w/v) aqueous $HgCl_2$ solution for 5 min and finally rinsed 5-6 times with sterilized distilled water. The sterilized seeds were germinated by soaking in sterile distilled water for 16 hrs in the dark on a orbital shaker at 200 rpm, near about 95% seeds germinated. Germinated seedlings were pre-cultured on semisolid MS Modified medium containing BAP (5 mg l^{-1}) up to 2 days at 27±2°C under light conditions for fast germination. Cotyledonary node and shoot tips explants were excised from germinated seedlings and cultured on MS Modified medium supplemented with growth regulators such as BAP in different concentrations. All the cultures were incubated in a culture room at 27 ± 2ºC under a 16/8-hrs light/dark photoperiod. Observations on the induction process were scored after a regular interval.

Multiple shoots (1.5-2 cm) originating from in and around of preconditioned explants region were separated and sub cultured on to fresh media for shoot elongation. The remaining portion of the explant along with shoot buds (< 1 cm) was transferred again on to fresh MSM media supplemented with hormones and used repeatedly up to 2-3 cycles. The effect of basal medium was also assessed by culturing the cotyledonary node and shoot tip explants on MS Modified basal medium (without hormones) containing 3% (w/v) sucrose.

The regenerated shoots (3-4 cm) were rooted on half strength MS medium supplemented with different concentration (0.1, 0.2, 0.3, 0.4 and 0.5) mg/l of IBA, IAA and NAA in test-tubes respectively. All the test-tubes were incubated in a culture room at 27 ± 2ºC under a 16/8-hrs light/dark photoperiod. Each treatment was performed in replications for root regeneration. Observations were recorded and scored after a regular interval.

After 4 weeks, *in vitro* grown rooted plants were removed from the adhering gel, washed thoroughly with tap water to remove the remaining medium and planted to culture boxes containing mixture of soilrite (soil: sand: peat moss) and nursery soil, irrigated with 1/4 MS salt solution at regular interval and covered with the transparent plastic bags (punctured to enable aeration) to avoid desiccation of the plantlets. They were acclimatized in controlled environmental conditions of culture room. After 3-4 weeks, plantlets were transferred in mixture of soilrite and nursery soil in pots and established in *in-vivo* conditions.

RESULT AND DISCUSSION

Two day old explants, excised from pre-cultured seedlings on BAP, were used for multiple shoots formation with different concentrations of BAP (0.25, 0.5, 1.0 and 1.5 mg l^{-1}). Explants were transferred higher (pre-culturing) concentrations to lower concentrations of BAP increased the number of shoots. Explants isolated from normal seedlings were used for 2 to 3 times for the induction of multiple shoots and Maximum number (15-16) of total shoot formation in two to three subcultures was found on 0.5 mg l^{-1}BAP in cotyledonary node (figure.1) and shoot tip (6-7) per explants. About 79 % cotyledonary node and 66 % shoot tips explants developed shoots at this concentration (Table.1).

Table 1. Regeneration of multiple shoots from explants of Lentil (L-4076) on MS Modified medium with different concentrations of BAP and Kinetin.

Explants	MS Modified medium with Supplements BAP (mg l^{-1})	No. of explants inoculated	No. of responsive explants	No. of shoots/explants (Mean value)	% of responsive explants
Shoot Tip	0.00	50	16	1	32
	0.25	80	42	2-3	52.5
	0.5	80	53	6-7	66.25
	1.0	80	45	1-2	56.25
	1.5	80	38	1	47.5
	0.0	50	12	1	24
	0.25	80	51	3-4	63.75

Cotyledonary Node	0.5	80	63	15-16	78.75
	1.0	80	53	4-5	66.25
	1.5	80	46	2-3	57.5

Explants inoculated on basal MS modified medium (without hormone) formed about only 32% shoots and 24% shoots from shoot tips and cotyledonary node explants respectively. Without hormones multiple shoots were not formed, only one shoot developed per explants (Table.1).

The effect of cytokinin to achieve multiple shoot regeneration of lentil (L-40760) cultivar using cotyledonary node and shoot tips explants with different concentration of BAP were evaluated. BAP induces greater multiple shoot regeneration after pre-socking and pre-culturing of seedlings. The percentage of explants regenerating adventitious shoots and the number of shoots per explant were higher when explants were prepared from pre-cultured seedlings. It was observed that better response was obtained when the 16 h old germinated seedlings were pre-cultured on high concentration of BAP before the explants excision. BAP is among the most active cytokinins- like substances and it induces greater in vitro shoot proliferation than many other cytokinins in Lentil plant.

Figure:1. Effect of BAP concentration on cotyledonary node explant

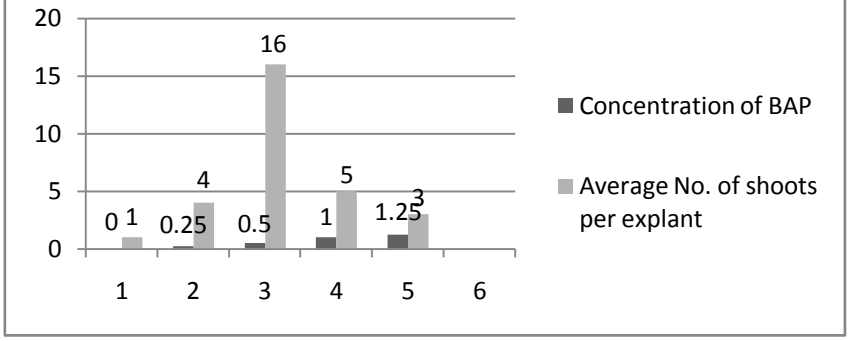
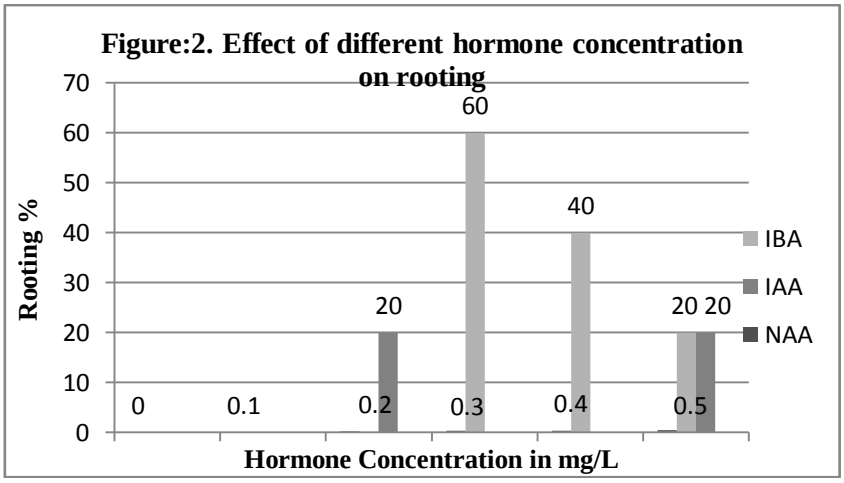


Figure:2. Effect of different hormone concentration on rooting



In vitro rooting is problematic in legumes since previous studies suggests difficulty in rooting of lentil microcuttings (Bajaj and Dhanju, 1979; Singh and Raghuvanshi, 1989; Polanco *et al.,* 1988; Mallick and Rashid, 1989; Malik and Saxena, 1992; Warkentin and McHughen, 1993; Fratini and Ruiz, 2002; Fratini *et al.,* 2003; Sarker *et al.,* 2003; Khawar *et al.,* 2004; Sevimay *et al.,* 2005). For rooting of regenerated shoots half strength MS medium supplemented with different concentration of auxins (IAA, IBA, and NAA) were used. The best rooting percentage, however, was observed on medium containing 0.3mg l^{-1} concentration of IBA, where rooting percentage was 60% followed by 0.4 mg l^{-1} concentration with 40% rooting percentage. Regenerated shoots rooted on medium containing IAA showed very low rooting percentage and there is no response on NAA supplemented medium (Table. 2).

The effect of auxins to achieve our aim to increase rooting percentage of lentil (L-4076) cultivar using regenerated shoots with different concentration of IBA, IAA and NAA were evaluated. IBA at 0.3 mg l^{-1}, 0.4 mg l^{-1} and 0.5 mg l^{-1} concentration induced

rooting in half strength MS medium. The best rooting response was observed on 0.3 mg l^{-1} concentration of IBA with 60% rooting percentage. Similarly, half strength MS medium supplemented with IAA at 0.2 mg l^{-1} and 0.5 mg l^{-1} concentration induced rooting but the rooting percentage was very low as compared to IBA. Thus, IBA is among the most responsive auxins which induce *in vitro* rooting in Lentil plant.

Table 2. Effect of various concentrations of Auxins on root regeneration of Lentil (L-4076) in half strength MS medium.

Treatments	1/2 MS with different concentration of hormone (mg/l)	Number of shoots cultured in medium	Number of roots regenerated in medium	Frequency of rooting (%)
IBA	0.0	20	0	0
	0.1	20	0	0
	0.2	20	0	0
	0.3	20	12	60
	0.4	20	8	40
	0.5	20	4	20
IAA	0.0	20	0	0
	0.1	20	0	0
	0.2	20	4	20
	0.3	20	0	0
	0.4	20	0	0
	0.5	20	4	20
NAA	0.0	20	0	0
	0.1	20	0	0
	0.2	20	0	0
	0.3	20	0	0
	0.4	20	0	0
	0.5	20	0	0

All *in vitro* regenerated plantlets were successfully acclimatized in culture bottles containing mixture of soilrite and nursery soil, irrigated with 1/4 MS salt solution. Plantlets grown in media containing IBA hormone were successfully established under greenhouse condition where they flowered and set seeds but the frequency of whole plant establishment was relatively better (50%) in this study. Earlier (Polanco and Ruiz 1997), studied the inhibitory effect of BAP on *in vitro* and *in vivo* root formation of lentil, concluded that success depends on the kind of cytokinin, its concentration and the time elapsed during shoot formation on these media prior transferring to rooting media. However, the method presented here may be more feasible than others described earlier.

CONCLUSION

In this investigation, we found that cotyledonary node explants were more responsive that shoot tips. Regeneration of many shoots via new meristem organogenesis may provide an opportunity for potentially increasing the number of individuals produced per explant. In the present study, the effect of adding BAP at 5 mg l^{-1} during seedling germination (pre-culturing of the explant) proved to be beneficial for early multiple shoot induction from cotyledonary node. Although there is a report on multiple shoot induction from cotyledonary node explants using TDZ (Amutha *et al.*, 2006; Gurel *et al.*, 2011) and by using BAP hormone (Khentry *et al.*, 2014). The present study highlights the significance of BAP pre-culturing of seedlings which resulted to increase in number of shoots per explants. In rooting of regenerated shoots different combination and concentration of IBA and IAA were used by (Tavallaie *et al.*, 2011; Muhammad Aasim 2012). (Khentry *et al.*, 2014) also reported rooting in six genotypes of lentil with low frequency at 1 mg/l NAA. In our study, the root formation was observed significantly on half strength MS medium containing 0.3mg l^{-1} concentration of IBA followed by 0.4 mg l^{-1} concentration. Increasing hormones concentration decreases the rooting percentage due to inhibitory effect. The higher number of shoots/seed and higher rooting percentage make the system developed the most efficient one for *in vitro* culture of lentil. This simple and efficient regeneration system can be adopted for mass propagation and for future genetic transformation studies in this economically important plant.

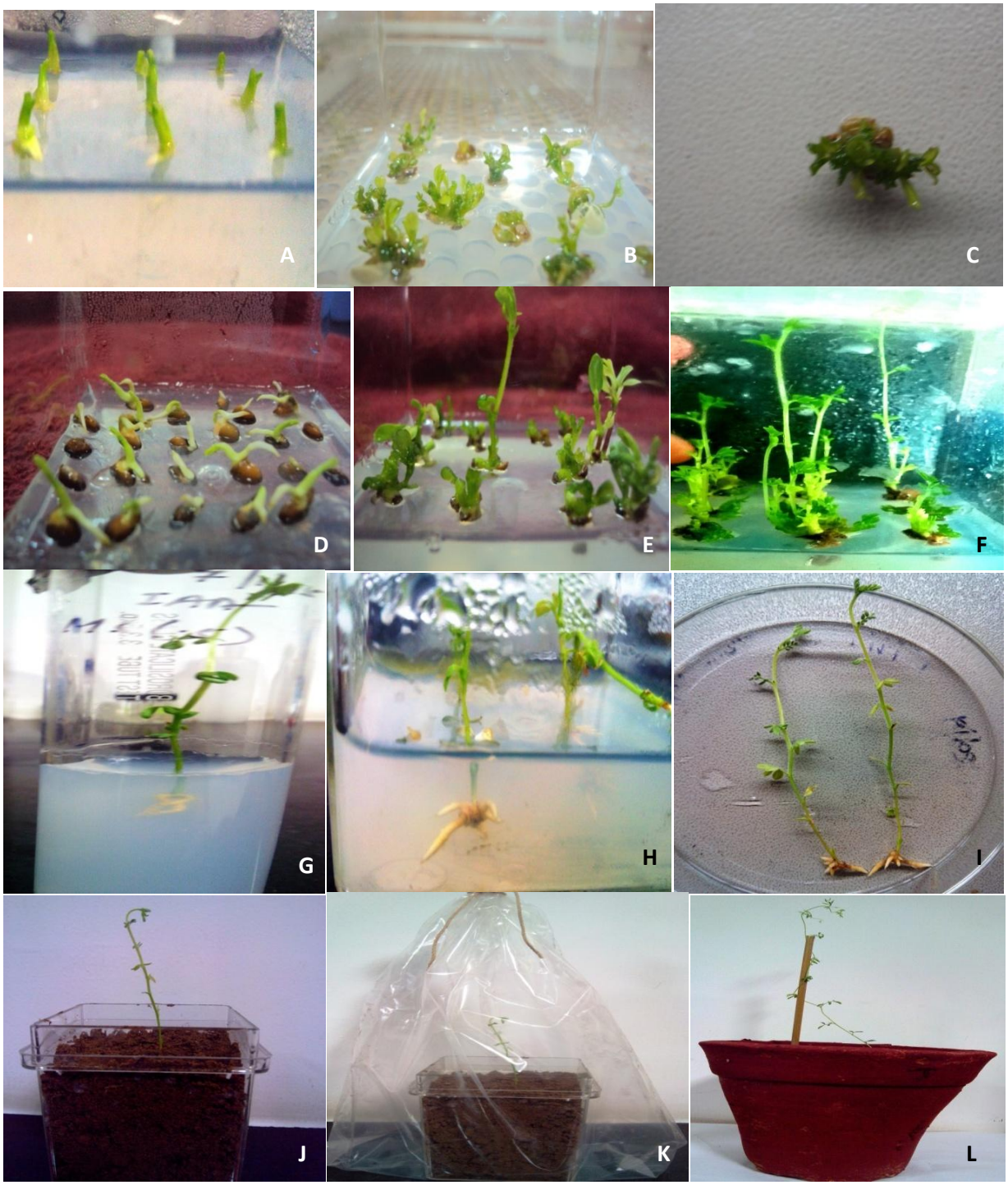


Figure: 3. ***In vitro*** **multiple shoots and roots formation from cotyledonary node of L-4076 on MS medium supplemented with hormones. (A) 2-d old Pre-cultured seedlings on BAP 5 mg l^{-1} (B) Inoculation of explants from and transfer on MSB media with 0.5 mg l^{-1} BAP. (C) Multiple shoots formation from cotyledonary node with 0.5 mg l^{-1} BAP (D) Explant with multiple buds (E-F) Sub-cultured shoot on fresh MSM media supplemented with hormones for elongation (G) Rooting of regenerated shoots in ½ strength MS medium supplemented with 0.5 mg l^{-1} IAA hormone (H) Rooting of regenerated shoots in ½ strength MS medium supplemented with 0.3 mg l^{-1} IBA hormone (I) Regenerated plantlets for establishment in soil (J-K) Establishment of regenerated plantlets in soilrite and nursery soil in** ***in vitro*** **conditions (L) Acclimatization of regenerated plantlets in** ***in vivo*** **conditions.**

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SEASONAL COVERAGE ANALYSIS OF SPATIO-TEMPORAL SATELLITE DATA OF INDIA

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Abstract: The decadal analysis of total cereal crops area and production with climatic factors viz. temperature and rainfall of India observed status of rabi and kharif season. India lies to the north of the equator between 6° 44'N and 35° 30'N latitude and 68° 7'E and 97° 25'E longitude. The analysis of time series (2000-01 to 2009-10) data of maximum and minimum temperatures of India R^2 values observed 0.003 and 0.013. The actual rainfall data analysis of 10 years R^2 value 0.002 and average rainfall observed 1120mm. The actual rainfall showed decreasing trend 972.8 mm in year 2009-10 and 981.4 mm in year 2002-03. The rainfall data variability observed due to changing of rainfall trend in India. The satellite imageries of SPOT VGT are used for crop coverage study of India. The overall analyses of decadal data are observed 58.1% for agricultural coverage and 41.9% for non-agricultural coverage uses. The Kharif (August) and Rabi (March) season agricultural coverage and Non-agricultural coverage observed 57.6% and 57.9% and 42.2% and 42.1% respectively. The brightness values based breakpoints were divided into two lands cover categories: Non-agricultural coverage and agricultural coverage. The distribution of tonal value (red to radish and yellow to greenish) visually observed on time series images, which are assigned a DN range from 0 to 255 for Non-agricultural and agricultural coverage. The decadal analysis of total cereal crops area and production with climatic factors viz. temperature and rainfall of India observed status of rabi and kharif season. The seasonal time series remote sensing SPOT VGT data is useful for understand changing of land use coverage in India

Keywords: DN Value, Rainfall, SPOT, VGT, Temperature

INTRODUCTION

GIS and remote sensing is an evolutionary science as a technology tools to help in various field such as forestry, agriculture, water, power and environment. The tools provide the facility to get result in fast accurate with reliable information. It gives information of changing to transform the real world scenario. The change is not always good but changes is universal truth of the world but very fast changing in climatic condition give adverse effect on crop health and also affect the quantity and quality of production and yield. The fast changing is observed in agriculture areas convert into urban areas. The changes are observed in IGP's states (Punjab, Haryana, Western Uttar Pradesh, Bihar and West Bengal) than southern states (Koshal, 2014). About 43% of India's geographical area is used for agricultural activity. Indian agriculture provides about 65% of the livelihood India has third rank for total cereals production and first rank in livestock population (Chhabra *et al*., 2009). The maximum coverage of Gangetic plains of total agricultural land of India is vast populated area and more than 70% population depend of agriculture land and their related work. Indian agriculture is mostly dependent on the rains for growing crops especially like cotton, rice oil seeds and coarse grains. The South –west monsoon accounts for 80% of the rainfall of India. The major crops are grown in India in three different seasons viz. rabi, kharif and Zaid. Kharif crops are sown at the beginning of South-West monsoon occurs from June through September. The rabi season starts with the onset of north-east monsoon in October. Many crops are cultivated in both kharif and rabi seasons. Rabi season required cool climate during growth period but warm climate during germination of seed and maturation. The Rabi crops are wheat, barley, gram, mustard and pea. Kharif crops are sorghum (Jowar), maize, sugarcane, rice and cotton (Duxburv *et al.,* 2000) Kharif crops are known as the summer or monsoon crops in Indian sub-continent. Rice and wheat is major staple crop of Rabi and kharif season. After analysis of three seasonal crops cycle observed India has rice-wheat system is pre-dominate cropping system (Yadav *et al.,* 2001)**.** It provides basic food to India's big populations which are living in rural or urban areas. The food availability as fodder in both season the livestock has been the mainstay of Indian agriculture sector and constitutes 21.3% of the country's livestock (including lactating dairy cattle, buffalo and goat). It is a major contributor to climate change; livestock play important roles in farming systems in India (in terms of food and income, fertilizer, soil conditioner and household energy). Livestock production is an important source of income and employment in the rural sector (Dastagiri, 2004). Indian agriculture is particularly vulnerable to impacts of climate change due to its large livestock population.

The food security is a big challenge in India for storage and safety. The food grain production growth are much improve but soil health decline most of the agricultural land due to maximum uses of chemical fertilizers, pesticides and weed control

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spray. The decadal analysis of total cereal crops area and production with climatic factors viz. temperature and rainfall of India observed status of rabi and kharif season. The seasonal time series remote sensing SPOT VGT data is useful for understand changing of land use coverage in India

MATERIAL AND METHOD

Study area : India lies to the north of the equator between 6° 44'N and 35° 30'N latitude and 68° 7'E and 97° 25'E longitude (Sheshakumar *et al.*, 2009). The total geographical area of the country is 3,287,590 Km^2 **.** India is the seventh largest country by geographical area in the world. It is bounded on the south west by the Arabian Sea and on the south east by the Bay of Bengal (Fig.1).

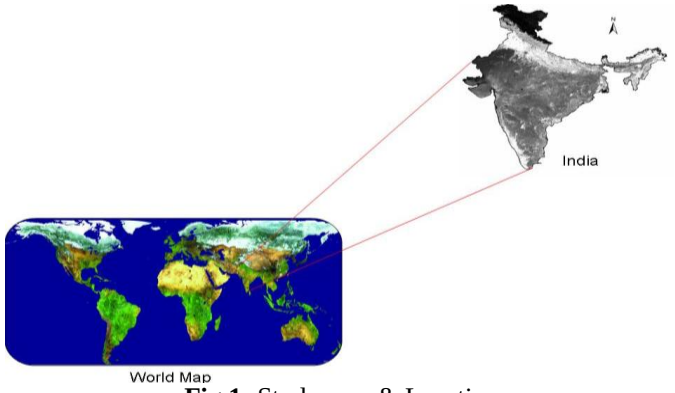


Fig.1: Study area & Location

The Planning Commission divided the country into 15 broad agro-climatic zones, National Agricultural Research Project (NARP) divided in 129 sub-zones and Indian Council of Agricultural Research (ICAR) divides India into 20 agro-ecological zones based on physiography, climatic condition, rainfall, cropping pattern, landform, soil and administrative units (Basu *et al.*, 1996). The present study is based on secondary sources of time series (2000 to 2012) viz. satellite images, Agriculture and climatic data of India were collected from the related websites, published records, report and bulletin, Directorate of Economics & Statistics, ICAR, IMD, CENSUS India, Vegetable Institute and other national level institute. The secondary data collection, arrangement, management and analysis are four steps for trend analysis work to get valuable information of crop converge of two seasons (Fig.2).

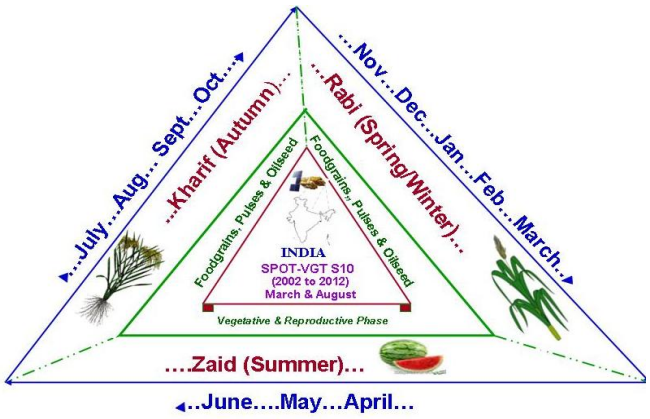


Fig. 2: Crop Calendar of India (Rabi, Kharif & Zaid)

Remote Sensing data is downloaded from SPOT VGT sites and processed with raster-based software ERDAS IMAGINE **(Earth Resources Data Analysis Systems)** and GIS software of the ESRI (Environmental Systems Research Institute).

SPOT (French: *Satellite Pour l'Observation de la Terre*, "Satellite for observation of Earth") is a high resolution, optical imaging earth observation satellite system. SPOT -4 was launched in 24 March 1998 (Elias, 2007). This satellite objective was to monitor human activities and natural phenomena (Table. 1). After a long journey, the satellite operation was terminated on 11 January 2013. The remote sensing data used in this study included the Single composite data set (1to10days) S10 NDVI data derived from VEGETATION sensor and useful for Vegetation study (SPOT websites: http://www.vgt.vito.be).

Table 1. Characteristics of selected satellite sensors

Satellite/Platform	SPOT-4
Instrument/Sensor	VGT-1
Data set/ Type	S10
Organization	CNES, France
Operation Period	1998-2013
Orbit type	Circular Sun-synchronous
Swath (km)	2250
Spatial Resolution	1150
Sensor Mission	Vegetation
Website	www.free.vgt.vito.be.
SPOT : Le Systeme Pour I'Observation de la Terre	

The study area (India) boundary feature file (.shp) was used for GIS layer in ARCGIS software to extracted information from remote sensing images. The remote Sensing data S10 was downloaded from the VGT free data product (1-km2 resolution) web portal sites. The imageries for the period year 2000 to 2012 for March (rabi) and August (kharif) in zip format data are used. The work station (hp Trinitron) with ERDAS IMAGINE 8.6 software was used for processing and analysis of remote sensing data. The images are downloading in Hierarchical Data Format (HDF) and Tagged File Format (TIFF) format and directly open in ERDAS IMAGINE to save in .img format. The dataset of SPOT VGT data were geometrically corrected with the help of the ground Control Points (GCPs) and WGS84 Geographic lat/ long projection system in ARCGIS. The GCPs (Ground Control Points) were distributed uniformly throughout the image with minimum root mean square (rms) error of less than 0.5 were selected. Polynomial transformation of 1st order was used because the correction programme runs faster with it and it also avoids geometric distortion in areas of very few GCPs. The study area subset with a vector polygon file (.shp file) representing the area boundary (AOI). Study area boundary overlay was done after completing geometric correction of the image (Fig.3). The series of temporal images were opened into the viewer of the ERDAS IMAGINE. The single band was stacked to create temporal series data (2000 to 2012) of March (for Rabi) and initial August (for Kharif) month. The images were convert in digital numbers (DN Values) based in to series of classes, so there corresponding all the dates were generated from DN values. The numbers of gray levels classes were identified based on colour range. These data are found very useful to study the dynamics of agricultural system at country or regional level. The major crops, different livestock, census, land uses and climatic data are integrated in the MS excel. The statistical information is the backbone of agricultural statistical system. The statistical analysis of data *viz.* Coefficient of Variation (CV), Correlation of Coefficient (R^2) and Trend Analysis of seasonal land use coverage give current scenario of changing pattern.

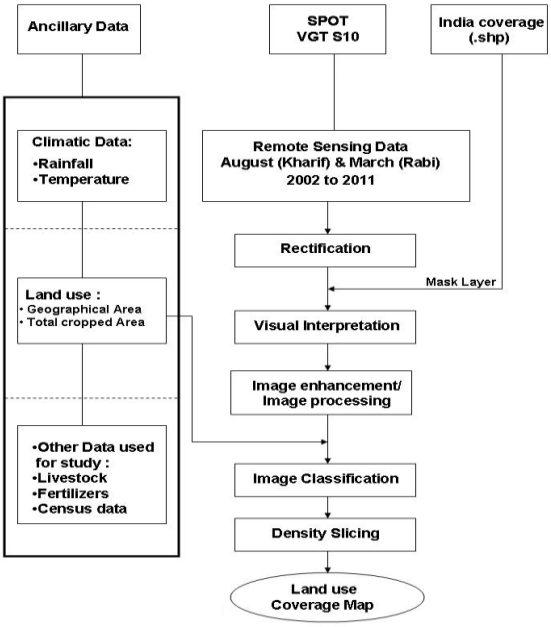


Fig. 3: Methodology used in the study

RESULT OR FINDING

The result or findings of paper is organized in three sections. While the first section discusses the climatic parameters and other related parameters. The second section is includes status of land use coverage, the third section is land use coverage of decadal trend of satellite and land use data of Rabi and Kharif season. The findings are discussed in sequence as under.

(I) Status of Climatic Parameters & other parameters

(i) Temperature data analysis

The analysis of time series (2000-01 to 2009-10) data of minimum and maximum temperatures of India R^2 values observed 0.003and 0.013 for maximum and minimum temperature (Fig.4). The decadal monthly data analysis are observed vulnerable change of temperature due to climatic change (Table.2). The change percentage not more but little change affected the rabi and kharif season crops. Due to rising or lowering temperature more affected on the seed germination and yield. The minimum and maximum temperature directly affected the foodgrains crop in terms of germination and yield (milking/ poding stage). The temperature is an important factor which affects plant growth development and yield. In the past century, daily minimum nighttime temperature increased at a faster rate than daily maximum temperature in association with a steady increase in atmospheric greenhouse gas concentrations (Karl *et al.* 1991 & Easterling, *et al.* 1997). After research observed in northern India temperature will increase 1°C wheat crop production decrease 10% (Janasky, 2012). The rabi season starting of cereal crops (wheat, pulses) temperature affected the germination of seeds. Warming of climate plant reproduction stage maximum affected and production will decrease. The summer monsoon, therefore, is responsible for both *kharif* and *rabi* crop production over India (Lyons, 1973).

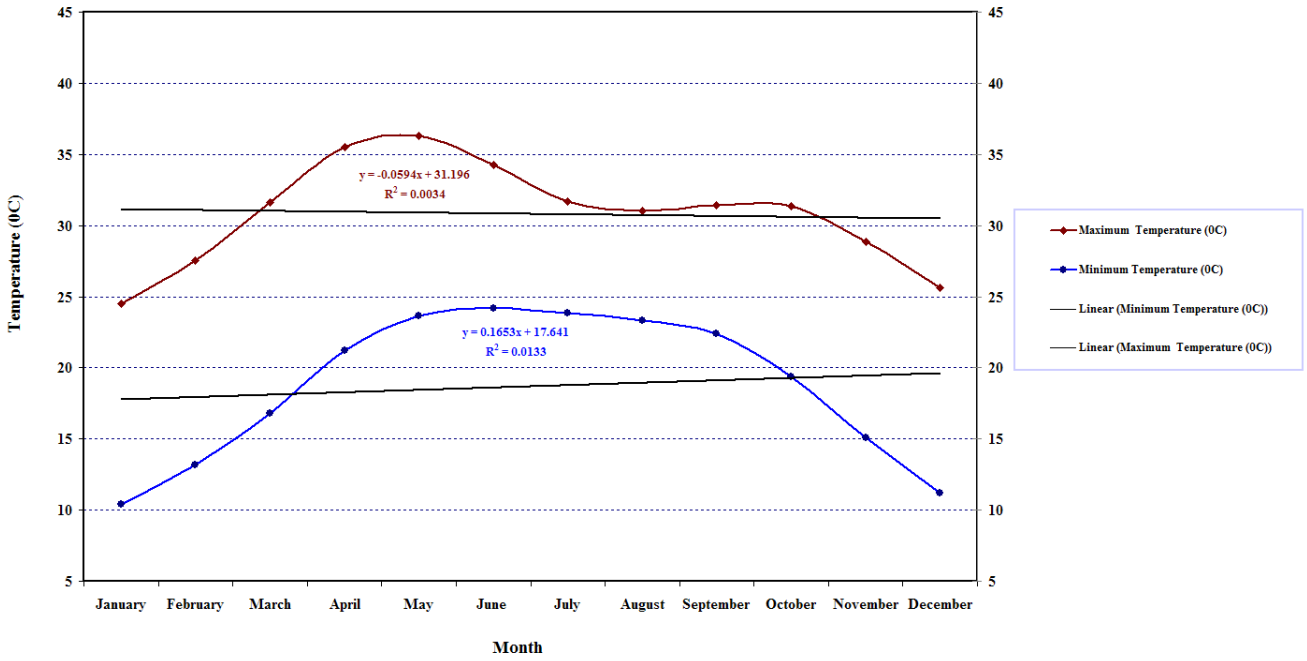


Fig. 4: Average Maximum and Minimum Temperature (^{0}C) of India (Year 2001-02 to 2010-11)

Table 2. Average Minimum and Maximum Temperature (^{0}C) of India (Year 2001-02 to 2010-11)

Temperature ^{0}C (Year 2001-02 to 2010-11)						
Month	Minimum Temperature (^{0}C)			Maximum Temperature (^{0}C)		
	Mean	SD	CV%	Mean	SD	CV%
January	10.4	0.4	4.0	24.5	0.6	2.6
February	13.2	0.7	5.1	27.6	1.4	5.1
March	16.8	0.6	3.5	31.6	0.9	2.8
April	21.2	0.4	2.1	35.5	0.7	1.9
May	23.7	0.3	1.4	36.3	0.4	1.2
June	24.2	0.4	1.7	34.3	1.0	2.9
July	23.8	0.3	1.3	31.7	0.7	2.1
August	23.3	0.2	0.7	31.0	0.2	0.6

September	22.4	0.3	1.1	31.4	0.4	1.3
October	19.4	0.4	2.3	31.3	0.6	2.1
November	15.1	0.6	4.3	28.8	0.3	1.1
December	11.2	0.6	5.1	25.6	0.3	1.2

(ii) Rainfall data analysis

Rainfall is important for food production plan, water resource management and all activity plans in the nature. The occurrence of prolonged dry period or heavy rain at the critical stages of the crop growth and development may lead to significant reduce crop yield. The actual rainfall data analysis of 10 years R^2 value 0.002 and average rainfall observed 1120mm. Rainfall is an important factor for food production and all related activity. The occurrence of prolonged dry period or heavy rain at the critical stages of the crop growth and development may lead to significant reduce crop yield. Around 90% of annual rainfall is received during monsoon season (June to October). According to new research global warming will decrease 70% monsoon rain and changing of weather water and food crises will be increase in coming years**.**

Table 3. Actual & Normal rainfall (mm) of India (Year 2002-03 to2011-12).

Year	**Actual Rainfall (mm)**	**Normal Rainfall (mm)**
2002-03	981.4	1205.4
2003-04	1278.0	1196.5
2004-05	1085.9	1197.3
2005-06	1185.4	1196.8
2006-07	1133.0	1195.5
2007-08	1180.2	1194.8
2008-09	1075.0	1196.4
2009-10	972.8	1195.6
2010-11	1212.3	1191.7
2011-12	1094.7	1186.9
Mean	**1119.9**	**1195.7**
SD	**97.9**	**4.6**
CV%	**8.7**	**0.4**

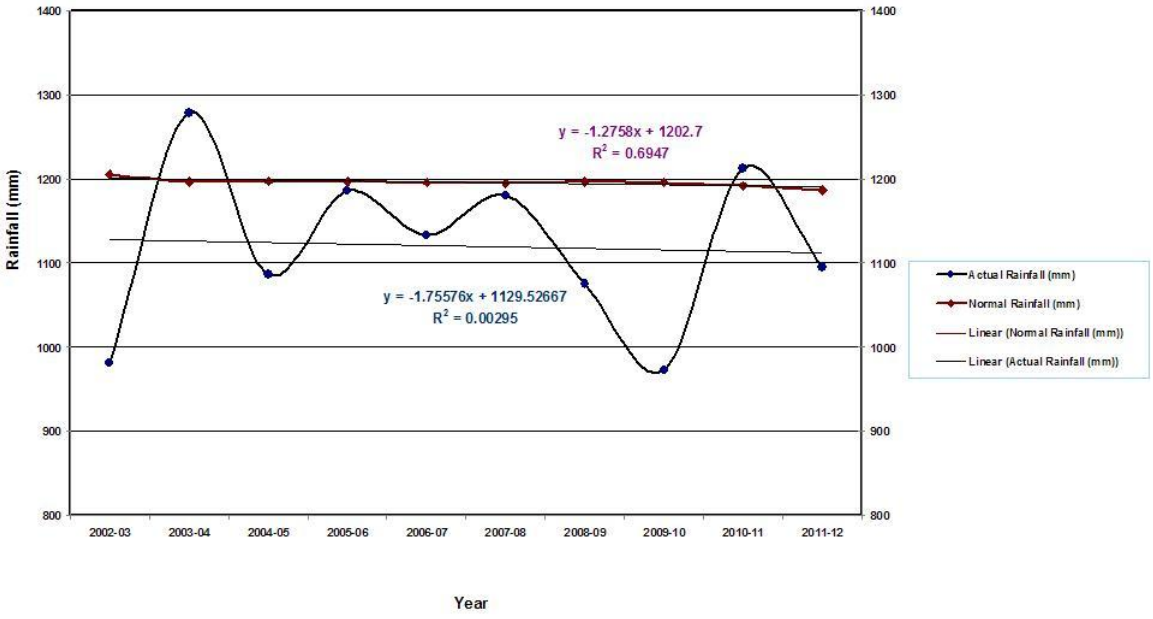


Fig. 5: Actual & Normal rainfall (mm) of India (Year 2002-03 to2011-12).

The mean standard deviation of all the study period was 98 mm. Moreover the coefficient of variation CV (%) 8.7 observed. More than 60% of the cropped area in India still depends solely on monsoon rainfall **(**Panigrahy *et al.* 2002). The normal rainfall R^2 =0.53 value with linear trend was

observed (Figure 5). The actual rainfall (Table 3) showed decreasing trend 972.8 mm in year 2009-10 and 981.4 mm in year 2002-03. In India, the onset of the southwest monsoon is expected in June or July, depending on location. The rainfall data variability observed due to changing of rainfall trend in India.

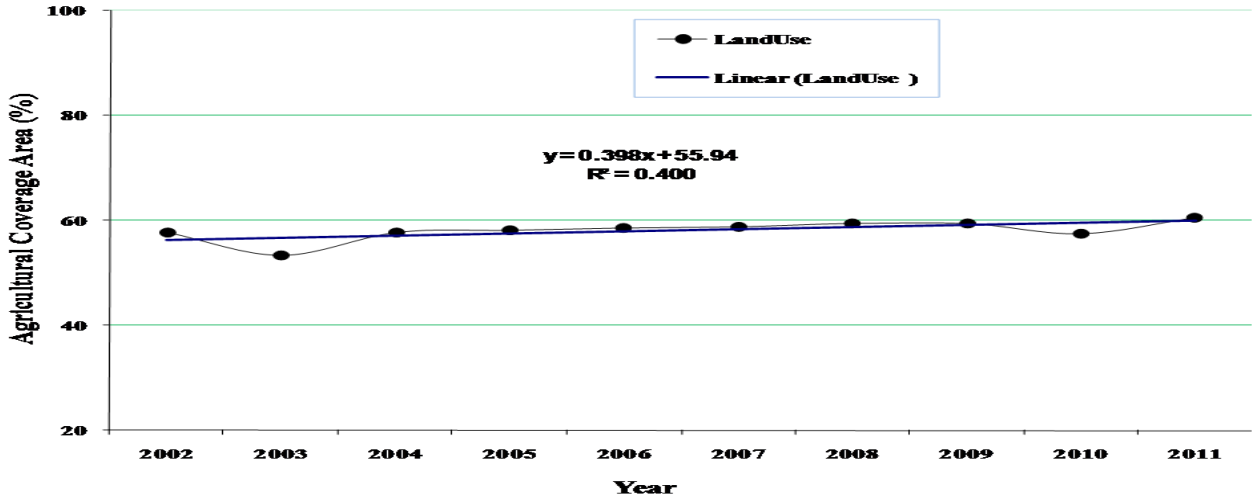
(II) Status of land use coverage of land use & satellite coverage of seasons

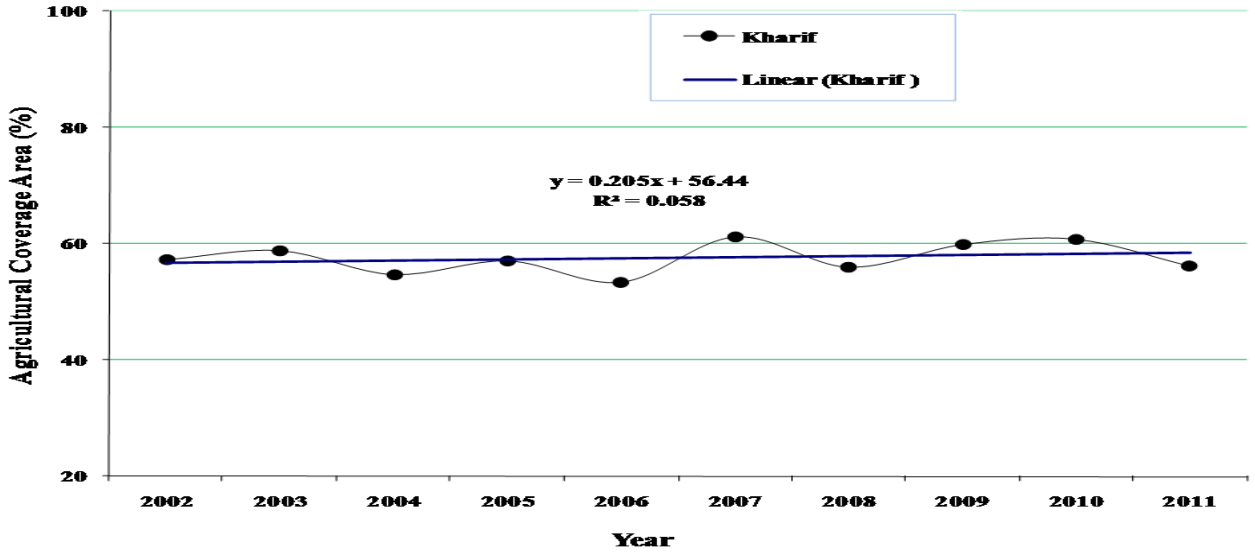
(a) Status of land use coverage classes

Land cover is one of the most important elements for the describing and studying the environment. India has about 2.4 % of the world's geographical area with support about 17% of the world's human population. Agriculture is an important sector of the Indian economy with 14% of the nation's GDP. The study relies on secondary data compiled from various published sources. For trend analysis, ten years (decadal) of different variables were calculated and compiled for the period 2002-03 to- 2011-12.

After analysis of land use classification based on different type of uses about half of total geographical area of 328.73 million hectare in the country is used for agriculture. The overall analyses of decadal data are observed 58.1% for agricultural coverage and 41.9% for non-agricultural coverage uses (Figure 6a &6b). The Kharif (August) and Rabi (March) season agricultural coverage and Non-agricultural coverage observed 57.6% and 57.9% and 42.2% and 42.1% respectively (Table 4).

Land degradation is major threat to our food, fodder and environmental security. Climate change is likely to impact agricultural land use and production due to less availability of water for irrigation. The use of modern varieties, irrigation and fertilizers are important factors that ensured higher growth in crop production.





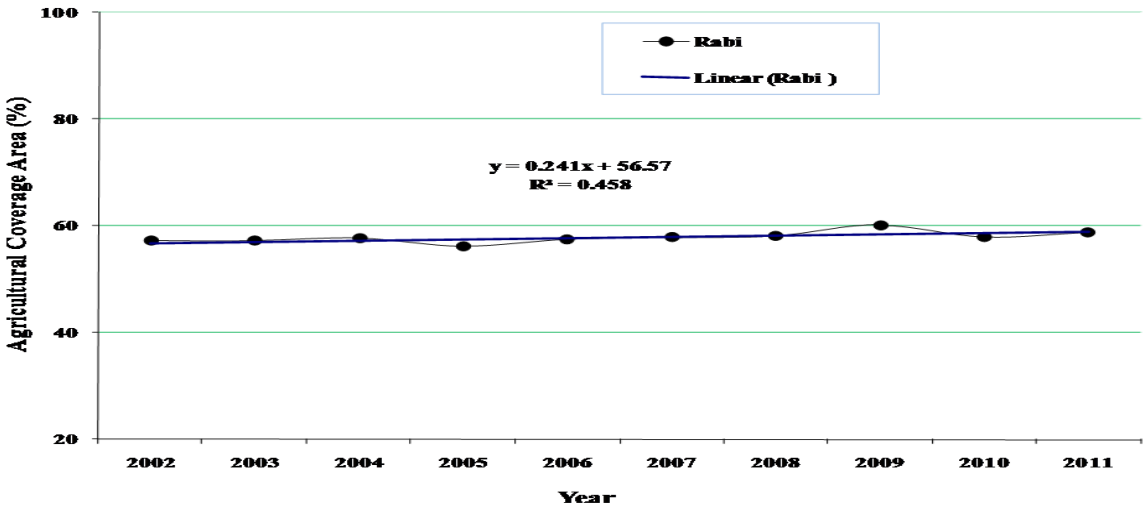
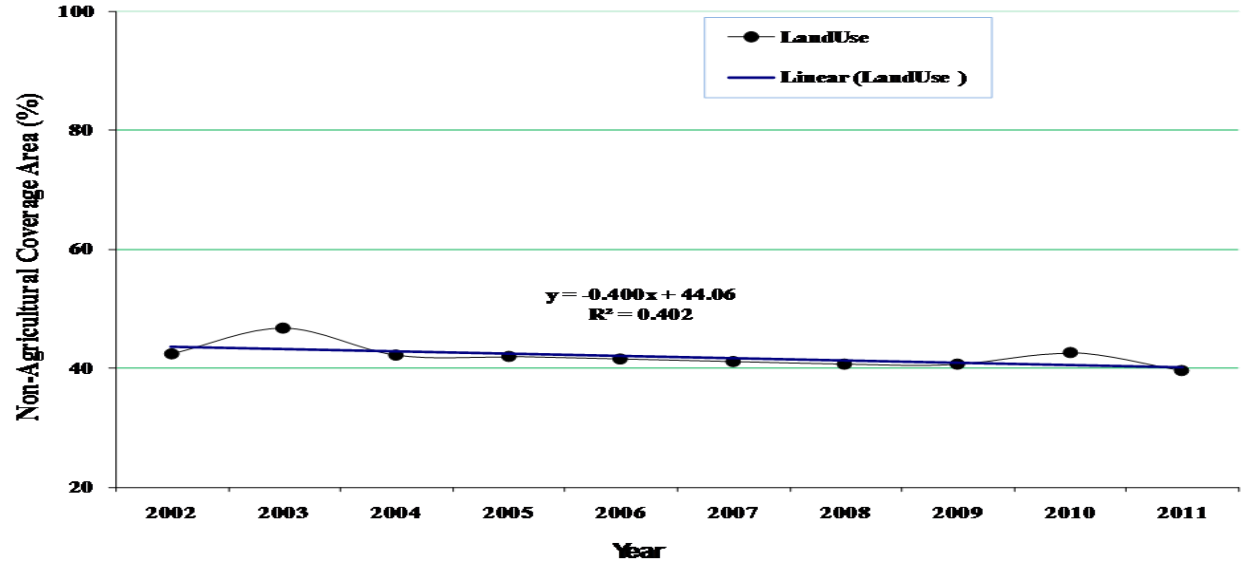
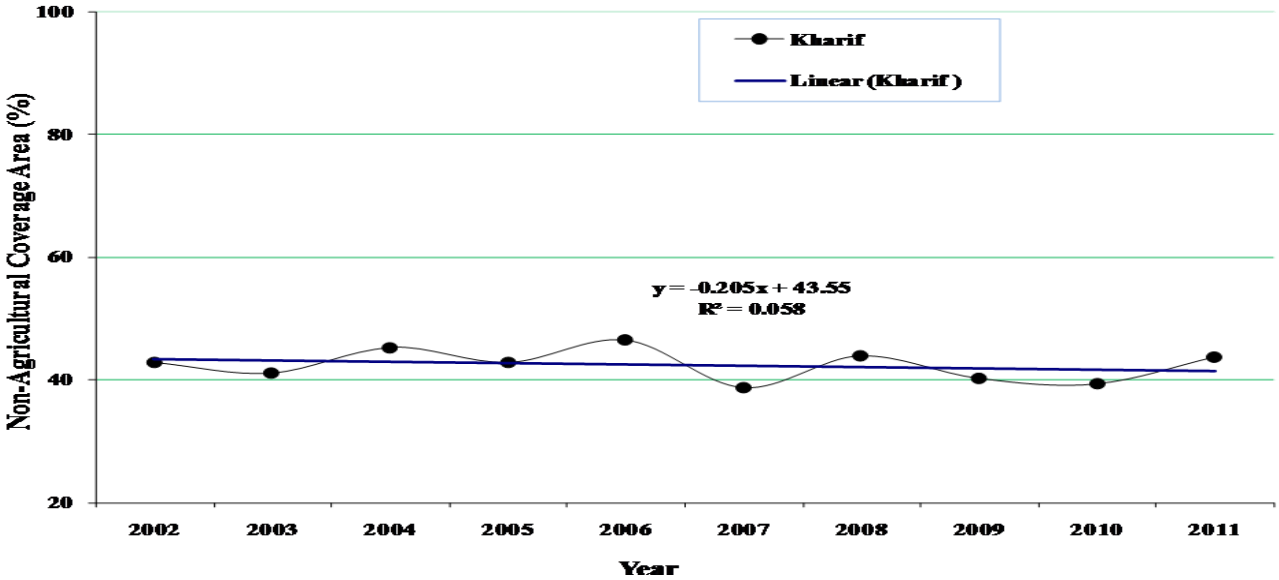


Fig. 6a: Temporal Landuse, Rabi &Kharif Agricultural coverage (%)of India (2002 to 2011)





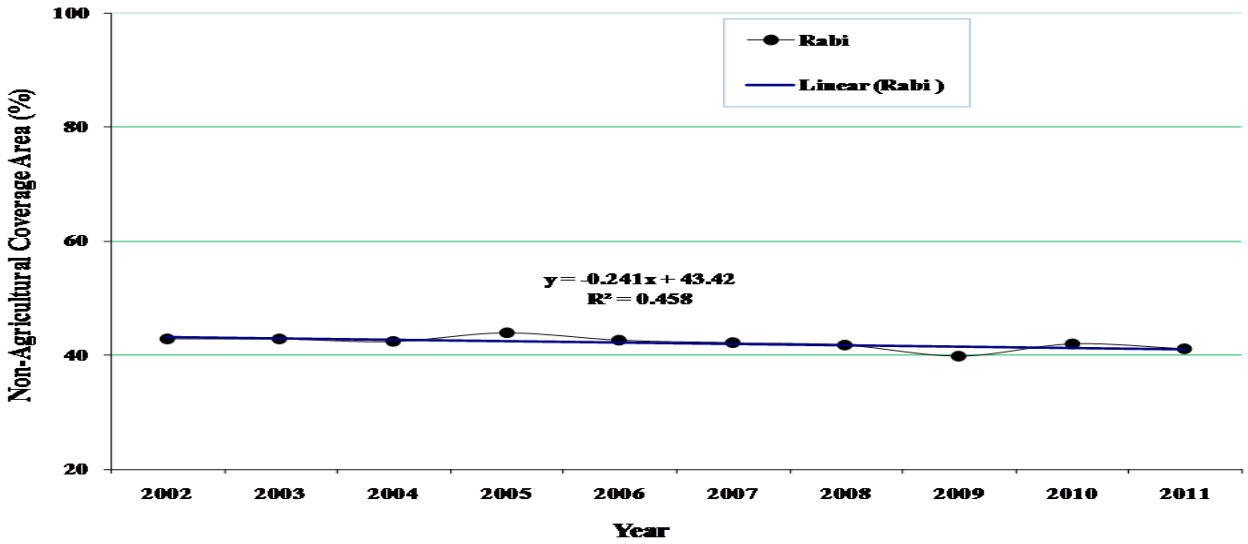


Fig. 6b: Temporal Landuse, Rabi & Kharif Non-Agricultural coverage (%) of India (2002 to 2011)

Table 4. Land Use & Satellite data Area Coverage Classes (%) of India

Year	Geographical Area ('000 Hectares)	Land Use Coverage ('000 Hectares)		Classes					
				Land Use Coverage		SPOT VGT S10			
						Kharif season: August		Rabi season: March	
		Total Cropped Area/ Agricultural Coverage ('000 Hectares)	Non- Total Cropped Area/ Non – Agricultural Coverage ('000 Hectares)	Agricultural Coverage	Non – Agricultural Coverage	Agricultural coverage	Non- Agricultural coverage	Agricultural coverage	Non- Agricultural coverage
2002	328726	189680	139046	57.7	42.3	57.2	42.8	57.2	42.8
2003	328726	175530	153196	53.4	46.6	58.9	41.1	57.2	42.8
2004	328726	190082	138644	57.8	42.2	54.8	45.2	57.7	42.3
2005	328726	191164	137562	58.2	41.8	57.2	42.8	56.2	43.8
2006	328726	192611	136115	58.6	41.4	53.5	46.5	57.5	42.5
2007	328726	193723	135003	58.9	41.1	61.3	38.7	57.9	42.1
2008	328726	195223	133503	59.4	40.6	56.1	43.9	58.2	41.8
2009	328726	195314	133412	59.4	40.6	59.9	40.1	60.2	39.8
2010	328726	188991	139735	57.5	42.5	60.7	39.3	58	42
2011	328726	198969	129757	60.5	39.5	56.3	43.7	58.9	41.1
Average	**328726**	**191129**	**137597**	**58.1**	**41.9**	**57.6**	**42.4**	**57.9**	**42.1**
			Standard Deviation	**1.91**	**1.91**	**2.58**	**2.58**	**1.08**	**1.08**
			CV%	**3.28**	**4.57**	**4.47**	**6.07**	**1.86**	**2.56**
					Correlation	**-0.19**	**-0.19**	**0.49**	**0.49**
					Covariance	**-0.85**	**-0.84**	**0.9**	**0.91**

(b) Status of land use & satellite coverage

Density slicing is a form of selective one-dimensional classification or pixel- based classification. The continuous gray scale of an image is "sliced" into a series of classes based on ranges **.** The group of brightness values were assigned to their respective land cover types, a pseudo-color image was generated in order to visually classify land cover types. The brightness values of pseudo-color image into defined intervals based on distribution of D.N. Values. The density slicing based classification provides an efficient land cover classification techniques. The numbers of slices are depending on the specific type of land cover which is defined by user **(**Wallin, 2012) was used density slicing method for eventual land cover classification. The brightness values based breakpoints were divided into two lands cover categories: Agricultural coverage and Non –

agricultural coverage assigned a DN ranges are 0 to 255. The two classes /cover type possessed a unique range and range was defined by DN values. The distribution of tonal value (red to radish and yellow to greenish) visually observed on time series images, which are assigned a DN range from 255 and Non agricultural coverage was assigned a DN range from 0 (Table 5). This technique help to determine generate true extent of land coverage map (Table 6). The average total pixel values are distributed 3577069 and 3289963 in kharif and rabi season of satellite images. The distribution of these pixel values in two broad classes. The percentage of pixel value in agricultural coverages class is observed in kharif season 57.5 and 57.9%. The percentage of pixel value in Non –agricultural coverage class is observed in Rabi season 42.4 and 42.1%.

Table 5: Distribution of pixel value and change coverage percentage of SPOT VGT (2002-2011) Image analysis of India

Cover type	**Season**	**D.N. Values**	**Tonal value**	**% of coverage area**
Agricultural coverage	Kharif	255	Yellow to greenish	57.58
	Rabi			57.90
Non-Agricultural coverage	Kharif	0	Red to radish	42.42
	Rabi			42.10

Table 6. Distribution of Pixels in Satellite data Area Coverage Classes (in numbers)

	SPOT VGT S10					
Satellite	**Kharif season: August**			**Rabi season: March**		
Year	**Total Pixels**	**Agricultural coverage of Pixels**	**Non-Agricultural coverage of Pixels**	**Total Pixels**	**Agricultural coverage of Pixels**	**Non-Agricultural coverage of Pixels**
2002	3577069	2047425	1529644	3289963	1882408	1407555
2003	3577069	2107321	1469748	3289963	1883353	1406610
2004	3577069	1959314	1617755	3289963	1897883	1392080
2005	3577069	2044310	1532759	3289963	1847443	1442520
2006	3577069	1912743	1664326	3289963	1890261	1399702
2007	3577069	2192875	1384194	3289963	1905327	1384636
2008	3577069	2005853	1571216	3289963	1914615	1375348
2009	3577069	2140897	1436172	3289963	1979615	1310348
2010	3577069	2172037	1405032	3289963	1909636	1380327
2011	3577069	2012358	1564711	3289963	1936808	1351550
Average	**3577069**	**2059513**	**1517556**	**3289963**	**1904725**	**1385238**

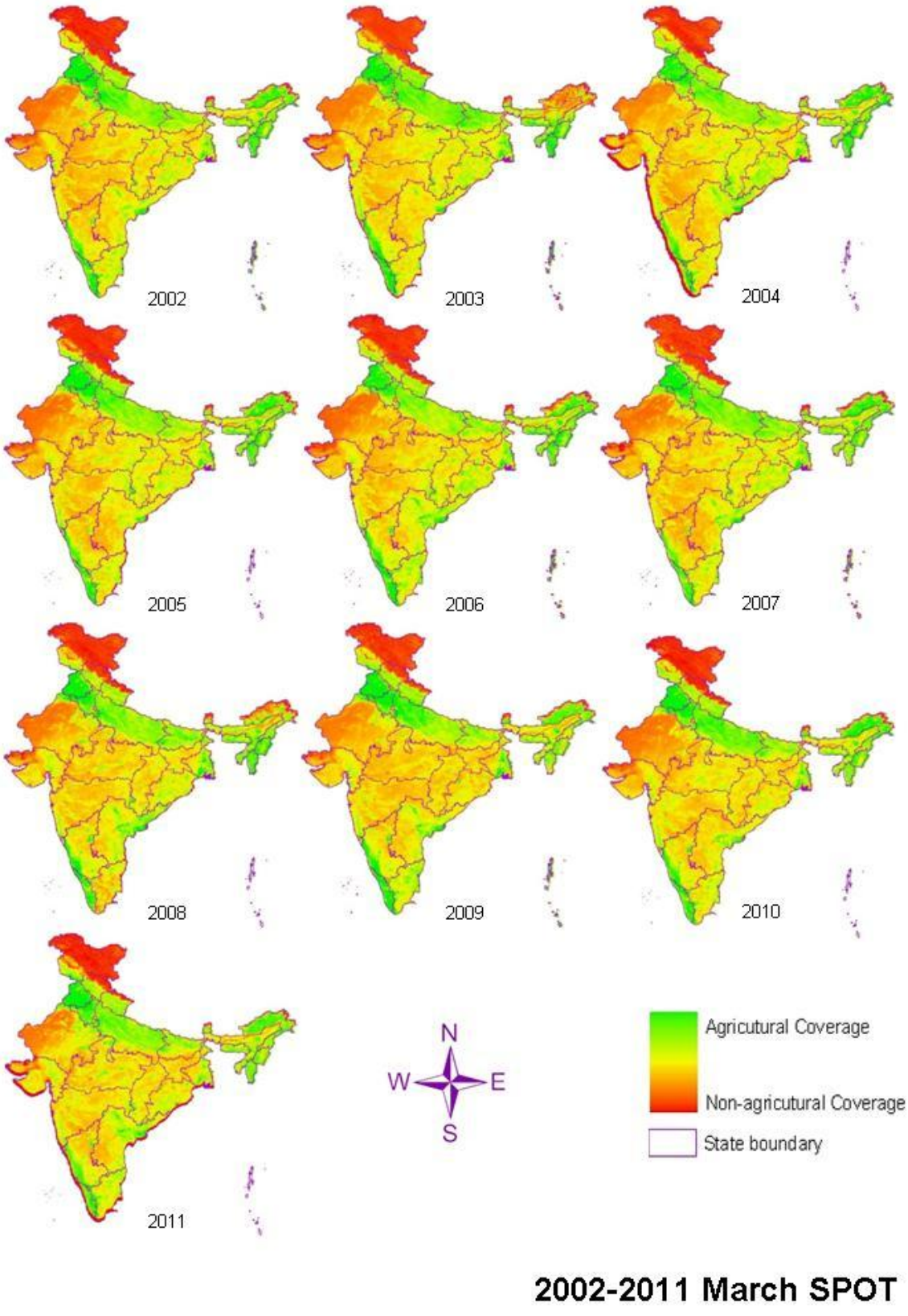


Fig.7: Rabi season map of India derived from multidate SPOT VGT data (March 2002 to 2011)

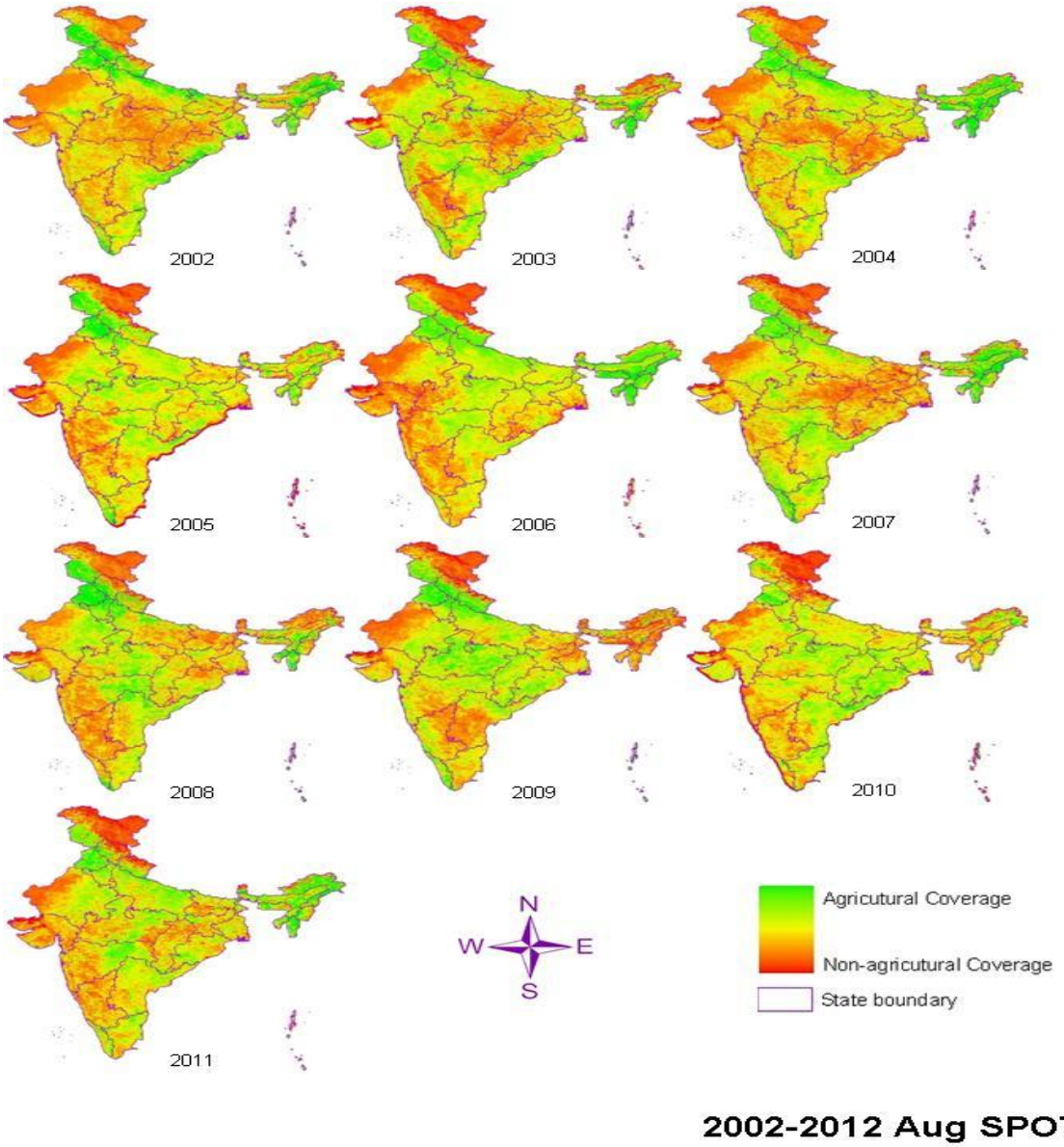


Fig. 8: Kharif season map of India derived from multidate SPOT VGT data (March 2002 to 2011)

CONCLUSION

GIS and remote sensing is an evolutionary science as a technology tools provide the facility to get result in fast accurate with reliable information. The major crops are grown in India in three different seasons viz. rabi, kharif and Zaid. Kharif crops are sown at the beginning of South-West monsoon occurs from June through September. After analysis of three seasonal crops cycle observed India has rice-wheat system is pre-dominate cropping system. The decadal analysis of total cereal crops area and production with climatic factors viz. temperature and rainfall of India observed status of rabi and kharif season. India is the seventh largest country by geographical area in the world. The Planning Commission divided the country into fifteen agro-climatic zones and twenty agro-ecological zones (ICAR). Remote Sensing data (2000 to 2012) is downloaded from SPOT VGT sites and processed with raster-based software ERDAS IMAGINE and GIS software of the ESRI. The analysis of time series (2000-01 to 2009-10) data of India R^2 values observed 0.003 and 0.013 for maximum and minimum temperature. The decadal monthly data analysis of ten year periods observed vulnerable change of temperature due to climatic change. The change percentage not more but little change affected the rabi and kharif season crops. Due to rising or lowering temperature more affected on the seed germination and yield. The actual rainfall data analysis of 10 years R^2 value 0.002 and average rainfall observed 1120mm. Rainfall is an important factor for food production and all related activity. The occurrence of prolonged dry period or heavy rain at the critical stages of the crop growth and development may lead to significant reduce crop yield. The actual rainfall showed decreasing trend 972.8 mm in year 2009-10 and 981.4 mm in year

2002-03. The Kharif (August) and Rabi (March) season agricultural coverage and Non-agricultural coverage observed 57.6% and 57.9% and 42.2% and 42.1% respectively. Land degradation is major threat to our food, fodder and environmental security. Climate change is likely to impact agricultural land use and production due to less availability of water for irrigation. The Density slicing based one-dimensional classification or pixel- based classification; the brightness values based breakpoints were divided into two lands cover categories: Non-agricultural coverage and Non –agricultural coverage assigned a DN ranges are 0 to 255. The average pixel values are distributed in the both season of satellite images. The percentage of pixel value in agricultural coverages class is observed in kharif season 57.5 and 57.9%. The percentage of pixel value in Non –agricultural coverage class is observed in Rabi season 42.4 and 42.1%. The time series SPOT VGT satellite images are useful for broad level land coverages study. The overall decadal data analysis of climatic factors: rainfall and temperature affect on the agricultural crop coverage area in both seasons.

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EVALUATION OF DIFFERENT INSECTICIDES AND PLANT PRODUCT AGAINST CHILLI THRIPS, *SCIRTOTHRIPS DORSALIS* AND THEIR EFFECT ON NATURAL ENEMIES

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Abstract: Ten insecticides *viz*, fipronil 5% SC, emamectin benzoate 5 SG, profenofos 50 EC, chlorpyriphos 20 EC, dimethoate 30 EC, indoxacarb 15.8 EC, metasystox 25 EC, neem oil 1%, agroneem 1.5% and NSKE 5% were evaluated under the field condition for ascertaining their bio-efficacy against chilli thrips, *Scirtothrips dorsalis*. Among the insecticides tested fipronil 5 SC @ 1000ml and emamectin benzoate 5 SC @ 250gm were equally found to be most effective against thrips. The application of emamectin benzoate 5 SG,and neem products were found safer for natural enemies (coccinellid beetle, *Menochiluss exmaculatus*, staphyllinid beetle, *Paederus* spp. and spider). The insecticides like fipronil 5 SC @ 1000ml/ha, chlorpyriphos 20 EC @ 1250 ml/ha, dimethoate 30 EC @ 850 ml/ha, indoxacarb 15.8 EC @ 500 ml/ha andmetasystox 25 EC @ 750 ml/ha were also not harmful to the natural enemies of chilli pest.

Keywords: Insecticides, Chilli thrips, Natural Enemies

INTRODUCTION

India is the largest producer of chilli. Chilli production level is however around 1.1 million tonnes annually. It is cultivated in all states and union territories of the country. As per the latest statistics, India produced 800,100 tonnes of dry chilli from an area of 930,000 hectare. Andhra Pradesh stands first in the list of chilli- producing states.(Anonymous, 2010).The major states growing chilli in the country are Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, TamilNadu, Uttar Pradesh, and West Bengal. The productivity is higher in the states of Andhra Pradesh and Tamil Nadu where chilli is grown under irrigated conditions than in Maharashtra and Karnataka, where the crop is raised mainly under rain fed situations.

Chilli is grown in all part of Chhattisgarh during rainy, spring and summer season. Inthis state the chilli production was 109908 metric tonnes from an area of 9187.25 hectares with average productivity of 11.97 metric tonnes per hectarein the year 2008-09 (Anonymous, 2010).

In India 20 insect pests are known to infest chilli crop, which affect the crop both quantitavely and qualitatively. *Scirtothrips dorsalis* Hood known as "chilli thrips" is one of the limitations for higher production of chilli crop and the losses in the yield of green chillies, from 60.5 to 74.3 per cent (Patel and Gupta, 1998).Insecticides, a major and vulnerable component in the pest management system, though giving a quick satisfactory control, cause many undesirable effect like toxicity to crop plants, harmful effect on natural enemies and non target species, environmental pollution, accumulation of toxic residue in soil, food stuff and development of resistance in insects. Further, insect resurgence of target pests following insecticidal application has become a wide spread phenomenon. The awareness of the safer use of the pesticides always leads in the limelight. Information on the safety of predators and parasite is scanty.

Organochlorines, organophosphate and carbamates are the group of pesticides commonly used in country. Synthetic pyrethroid has been used extensively in vegetable crop. Most organochlorine compound persists in the ecosystem for long time and hence pollute environment. The organophosphate and carbamates are less persistent but may lack selectivity. Synthetic pyrethroids are effective in low doses against caterpillar pest but have some other problem. All the groups of pesticides are known to induce resurgence of pest with varying degree (Jayaraj, 1987).

Hence, there is a need to manage these pests, effectively and economically in chilli. No sincere attempt has been made in the past to evaluate the efficacy of newer insecticides against these pests.

MATERIAL AND METHOD

The experiment was conducted during *rabi-summer* season 2010-11 at Mango orchard, Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G).The general climate is hot with mid winter followed by monsoon period of about four to five months. It receives an average rainfall of 1000-1350 mm per annum mostly concentrated during June to September with occasional showers in winter. The maximum temperature goes to high as 46^0C during the summer month and minimum as low as 6^0C during the winter. The atmospheric humidity is high from June to October.

The field experiment was conducted with ten insecticides treatments and untreated controlin randomized block design with four replications

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following a spacing of 45 x 30 cm in a treatment plot size of 5 x 3 m. Chilli variety, Pusa Jwala was used for the experiment. Ten insecticides namely fipronil 5 SC, emamectin benzoate 5 SG, profenophos 50 EC, chlorpyriphos 20 EC, dimethoate 30 EC, indoxacarb 15.8 EC, metasystox 25 EC, neem oil 1%, agroneem 0.15% EC and NSKE 5%were tried for their efficacy against chilli thrips (Treatment details are given in table-1).

Table 1. Treatment details for bio-efficacy studies.

Treatment	Name of treatment	Dose/ha
T1	Fipronil 5 SC	1000 ml/ha
T2	Emamectin benzoate 5 SG	250 g/ha
T3	Profenophos 50 EC	750 ml/ha
T4	Chlorpyriphos 20 EC	1250 ml/ha
T5	Dimethoate 30 EC	850 ml/ha
T6	Indoxacarb 15.8 EC	500 ml/ha
T7	Metasystox 25 EC	750 ml/ha
T8	Neem oil 1%	5000 ml/ha
T9	Agroneem 0.15% EC	1250 ml/ha
T10	NSKE 5%	12.50 lit./ha
T11	Untreated control	-

Totally two sprays were taken. The first spray was taken only when the incidence of chilli thrips crossed economic threshold revel at vegetative stage and second spray was taken at reproductive stage of crop. Observations were recorded on the number of thrips per three leaves per plant on randomly selected 5 plants/plot before and after 3, 5,7and 15 days after treatment.

The population of natural enemies *viz*; coccinella beetle, staphyllinid beetle and spider were also recorded in same manner on whole plant.

The data were converted to square root transformation before statistical analysis.

RESULT AND DISCUSSION

Impact of insecticides on chilli thrips population

The comparative evaluation of prevalent insecticides, newer moleculeand plant products has been evaluated against chilli thrips (Table-2). The pre-treatment observation was taken at one day before spraying of insecticides. The post treatment observation was taken at 3, 5, 7, and 15 DAS. The influence of treatment in the form of population reduction trend was as follows:

In pre-treatment observation, the thrips population was ranging from 15.80 to 18.20 insects on three leaves per plant. The population was found almost uniform in the all plots. As there was no significant differences observed among them.

As it is clearly evident, from the table-2 that three days after 1stspraying of insecticides, the insecticide fipronil 5 SC@ 1000ml/ha recorded the least thrips population (7.95 thrips on three leaves per plant). It was followed by, emamectin benzoate 5 SG @ 250 g/ha (8.6 thrips on three leaves/plant) and both the treatments were statistically at par. Other all the insecticidal application such as dimethoate 30 EC @ 850 ml/ha, chlorpyriphos 20 EC @1250 ml/ha, metasystox 25 EC @ 750 ml/ha, agroneem 1.5% @ 1250 ml/ha, profonofos 50 EC @ 750 ml/ha, indoxacarb 15.8 EC @ 500 ml/ha and neem oil 1% @ 5000 ml/ha was effective in decreasing manner but among treatments NSKE 5% @ 12.50 lit/ha, recorded the highest thrips (14.90) population. In untreated plot there was maximum population of thrips (33.35 thrips on three leaves per plant) which was statistically higher than all the other treatments.

After five days of 1st spraying of insecticides, the insecticide fipronil 5 SC @ 1000 ml/ha again recorded the least thrips population (5.80 thrips) and was followed by emamectin benzoate 5 SC @ 250ml/ha and both the treatments were statistically at par. Among all the spray application NSKE 5% @ 12.50 lit/ha, recorded the maximum thrips (15.90) population. In untreated plot there was maximum population of thrips (25.65 thrips on three leaves per plant) recorded which was statistically higher than all the other treatments.

After 7 DAS of 1st spray of insecticides, the observation clearly showed that fipronil 5 SC had least thrips population (6.95 thrips on three leaves per plant). It was followed by emamectin benzoate 5 SG @ 250 g/ha and both treatments were statistically at par. Other all the insecticidal application such as indoxacarb 15.8 EC @ 500 ml/ha, dimethoate 30 EC @ 850 ml/ha, chlorpyriphos 20 EC @ 1250 ml/ha, neem oil 1% @ 5000 ml/ha, metasystox 25 EC @ 750 ml/ha, agroneem 1.5% @ 1250 ml/ha and profonofos 50 EC @ 750 ml/ha, were also effective in decreasing the pest but among the treatments. NSKE 5% @ 12.50 lit/ha, recorded the maximum thrips (26.50) population.

After 15 DAS of 1st spraying of insecticides, all the insecticidal treatment proved significantly superior in reducing the thrips population as compared to untreated control. Fipronil 5 SC @1000ml/ha recorded the least thrips population (29.30 thrips be three leaves per plant) followed by emamectin benzoate, indoxacarb, chlorpyriphos, profenofos, metasytox, dimethoate. Among the treatments agroneem having maximum thrips (88.75 per three leaves/plant).

During second spray 3, 5, 7 & 15 days after spraying of insecticides, the lowest thrips population was recorded in finpronil i.e. 9.88, 8.80, 7.68 and 37.35 thrips per three leaves/plant, respectively. The second best treatment was emamectin benzoate with thrips population of 10.70, 9.20, 9.40 and 41.20 per three leaves per plant and both the treatments were statistically at par. The thrips population was recorded maximum in the NSKE @5% among the treatments with 17.35, 23.40, 27.20 and 72.20 thrips population, respectively and in untreated control it was 111.95, 124.85, 44.00 and 132.00 thrips per three leaves per plant after 3,5,7 and 15 days of spraying of insecticides.

The present findings are in conformity with several other workers *viz.*,Reddy *et al*. (2005 and 2007) who reported, the fipronil 5 SL 0.01% and dimethoate 30 EC 0.06% was the most effective against the thrips while, chlorpyriphos 20 EC @ 0.05%, was the least effective against thrips. Emamectin benzoate @10g a.i. /ha (4.71/leaf) are also reported superior in managing thrips incidence (Khalid and Prasad; 2009). Fipronil 0.3 G granules @ 40 to 60 m^2 bed and fipronil 5 SC @ 40 to 60 gm a.i. /ha were used in soil and foliar spray and found the crop free from the incidence of thrips (Rupal *et al*., 2002). Chandrasekaran and Veeravel, (1998) tested plant products against thrips and found achook (1.5%) as the most effective followed by neem oil (at 3 and 5%). Neem cake extract 5% was the least effective treatment.

Impact of insecticides on natural enemies

In pre-treatment observation, the coccinella, staphyllinid and spider population was ranging from 1.07 to 1.65, 0.85 to 1.05 and 1.30 to 1.45 per plant respectively. The population was found homogenous in the all treatments. There was non-significant difference observed among them.

After 1st spray it is clearly evident from the table 3, 4 & 5 that among the treatments after three days of spraying of insecticides, emamectin benzoate 5 SG @ 250 g/ha recorded the maximum natural enemies population (1.35 coccinella, 1.10 staphyllinid and 0.85 spider per plant), while in untreated plots there was maximum population of coccinella (1.60/per plant), staphyllinid (1.30 per plant) and spider (1.50 per plant) which was statistically higher than all other treatments.

In five days after spraying of insecticides the insecticide, emamectin benzoate 5 SG @ 250 g/ha recorded the maximum coccinella population (1.25 coccinella per plant) among the treatments. In case of staphyllinid and spider there was non significant differences observed among all the treatment. In untreated plot there was maximum population of coccinella, staphyllinid and spider (1.50, 0.85 and 1.05 per plant) recorded and it was statistically higher than all other treatments.

After 7 & 15 days there was no significant difference among all treatments regarding natural enemies' population.

The trend of natural enemies' population after second spray was similar as that of first spray where maximum population of coccinellid beetle, staphyllinid beetle and spider were recorded in untreated control. But almost was non significant with other insecticidal treatments.

The present findings are in conformity with several other workers who reported the efficacy of different insecticidal molecules *viz.*, indoxacarb 14.5 SC @ 500 ml/ha and the combination with other insecticides where it did not influence the natural enemy, coccinellid at Dharwad during 2005-2006 (Nandihalli, 2009).

From the above study, it is cleared that the spraying of emamectin benzoate 5 SG @ 250 g/ha, is saffer for conservation of coccinellid population.

Table 2. Evaluation of different insecticides against chilli thrips *Scirtothrips dorsalis* (thrips population/3 leaves/plants)

Treat. no.	Insecticides	Dose (ha)	After 1st spray					After 2nd spray				
			pre treat ment	post treatment				pre treat ment	post treatment			
				3 DAS	5 DAS	7 DAS	15 DAS		3 DAS	5 DAS	7 DAS	15 DAS
T1	Fipronil 5 SC	1000 ml	18.20 (4.26)*	7.95 (2.81)	5.80 (2.49)	9.30 (3.13)	29.30 (5.46)	227.00 (15.04)	9.88 (3.22)	8.80 (3.05)	7.68 (2.86)	37.35 (6.15)
T2	Emamectin Benzoate 5 SG	250 gm	16.80 (4.10)	8.60 (2.94)	6.65 (2.66)	10.70 (3.34)	31.50 (5.65)	257.70 (16.3)	10.70 (3.34)	9.20 (3.11)	9.40 (3.14)	41.2 (6.45)
T3	Profenophos 50 EC	750 ml	16.40 (4.05)	13.80 (3.78)	14.35 (3.85)	25.70 (5.10)	79.20 (8.92)	226.20 (14.98)	14.20 (3.77)	19.98 (4.52)	21.80 (4.69)	64.46 (8.05)
T4	Chlorpyriphos 20 EC	1250 ml	17.80 (4.22)	13.30 (3.71)	14.45 (3.86)	16.70 (4.11)	72.20 (8.52)	233.10 (15.21)	15.20 (3.94)	19.40 (4.46)	22.40 (4.75)	65.84 (8.14)
T5	Dimethoate 30 EC	850 ml	16.40 (4.04)	13.20 (3.70)	14.75 (3.90)	14.65 (3.82)	79.40 (8.94)	242.50 (15.50)	13.90 (3.76)	18.80 (4.38)	23.20 (4.48)	64.50 (8.03)
T6	Indoxacarb 15.8 EC	500 ml	17.20 (4.15)	13.85 (3.78)	14.80 (3.89)	12.10 (3.53)	62.40 (7.93)	216.50 (14.67)	15.35 (3.91)	18.60 (4.37)	20.60 (4.59)	63.65 (8.00)
T7	Metasystox 25 EC	750 ml	17.80 (4.22)	13.65 (3.76)	14.70 (3.90)	22.70 (4.70)	76.40 (8.77)	221.95 (14.88)	14.05 (3.78)	19.80 (4.50)	21.4 (4.68)	63.89 (8.00)
T8	Neem oil 1%	5000 ml	15.80 (3.97)	14.10 (3.80)	15.85 (4.04)	18.40 (4.28)	86.70 (9.34)	192.00 (13.82)	17.10 (4.14)	23.20 (4.82)	25.20 (5.05)	73.75 (8.61)
T9	Agroneem 1.5%	1250 ml	16.60 (4.07)	13.70 (3.76)	15.35 (3.98)	25.55 (5.10)	88.75 (9.45)	209.30 (14.45)	16.80 (4.09)	22.60 (4.81)	24.80 (5.02)	65.75 (8.13)
T10	NSKE 5%	12.50 lit.	17.40 (4.17)	14.90 (3.92)	15.90 (4.65)	26.50 (5.16)	86.80 (9.34)	211.70 (14.50)	17.35 (4.13)	23.40 (4.89)	27.20 (5.26)	72.20 (8.52)
T11	Control	-	16.60 (4.07)	33.35 (5.79)	25.65 (5.11)	33.65 (5.82)	111.20 (10.48)	238.05 (15.30)	111.95 (10.55)	124.85 (11.17)	44.00 (6.65)	132.00 (11.51)
SE(m)			0.09	0.27	0.11	0.25	0.21	0.65	0.31	0.14	0.12	0.23
C.D. at 5%			NS	0.76	0.32	0.70	0.59	NS	0.88	0.39	0.35	0.66

Note: * Figure in parantheses are transformed value $\sqrt{x} + 0.5$
DAS = Days after spraying of insecticides.

Table 3. Effect of insecticides on coccinellid beetle population.

Treat. no.	Insecticides	Dose (ha)	After 1st spray					After 2nd spray				
			pre treatment	post treatment				pre treatment	post treatment			
				3 DAS	5 DAS	7 DAS	15 DAS		3 DAS	5 DAS	7 DAS	15 DAS
T1	Fipronil 5 SC	1000 ml	1.50 (1.41)*	0.90 (1.18)	0.80 (1.13)	0.70 (1.09)	1.20 (1.29)	1.15 (1.28)	0.50 (0.99)	1.05 (1.24)	0.85 (1.16)	1.00 (1.22)
T2	Emamectin Benzoate 5 SG	250 gm	1.30 (1.34)	1.35 (1.36)	1.25 (1.31)	1.00 (1.21)	0.90 (1.18)	1.25 (1.32)	0.65 (1.07)	1.35 (1.36)	1.00 (1.22)	0.95 (1.20)
T3	Profenophos 50 EC	750 ml	1.07 (1.25)	0.75 (1.12)	0.65 (1.07)	0.75 (1.12)	1.15 (1.28)	1.15 (1.28)	0.60 (1.03)	0.80 (1.14)	0.95 (1.20)	1.00 (1.22)
T4	Chlorpyriphos 20 EC	1250 ml	1.30 (1.34)	0.55 (1.01)	0.45 (0.97)	0.80 (1.13)	0.90 (1.18)	0.85 (1.16)	0.80 (1.05)	0.60 (1.11)	0.65 (1.07)	1.05 (1.24)
T5	Dimethoate 30 EC	850 ml	1.60 (1.44)	0.75 (1.12)	0.65 (1.05)	0.85 (1.13)	0.90 (1.18)	1.25 (1.32)	0.65 (1.07)	1.05 (1.24)	0.80 (1.14)	1.15 (1.28)
T6	Indoxacarb 15.8 EC	500 ml	1.40 (1.38)	0.70 (1.09)	0.60 (1.05)	0.80 (1.13)	1.00 (1.21)	1.10 (1.26)	0.55 (1.02)	1.00 (1.22)	0.80 (1.14)	1.05 (1.24)
T7	Metasystox 25 EC	750 ml	1.65 (1.46)	0.60 (1.05)	0.50 (0.99)	0.95 (1.20)	0.95 (1.19)	0.95 (1.19)	0.55 (1.02)	0.95 (1.20)	0.80 (1.13)	1.10 (1.26)
T8	Neem oil 1%	5000 ml	1.60 (1.45)	0.80 (1.13)	0.70 (1.06)	0.65 (1.07)	0.85 (1.16)	1 .00 (1.22)	0.45 (0.97)	0.95 (1.20)	0.85 (1.16)	1.05 (1.24)
T9	Agroneem 1.5%	1250 ml	1.65 (1.46)	0.55 (1.02)	0.45 (0.97)	0.85 (1.15)	1.15 (1.26)	1.10 (1.25)	0.45 (0.97)	1.00 (1.22)	0.85 (1.16)	1.35 (1.34)
T10	NSKE 5%	12.50 lit.	1.25 (1.32)	0.55 (1.02)	0.45 (0.97)	0.75 (1.11)	0.90 (1.18)	1.05 (1.24)	0.60 (1.05)	1.25 (1.32)	0.95 (1.20)	0.95 (1.20)
T11	Control	-	1.50 (1.41)	1.60 (1.45)	1.50 (1.41)	1.25 (1.32)	1.05 (1.22)	1.20 (1.30)	1.15 (1.28)	1.80 (1.51)	1.45 (1.39)	1.05 (1.25)
SE(m)			0.05	0.05	0.07	0.07	0.08	0.06	0.06	0.05	0.05	0.06
C.D. at 5%			NS	0.16	0.22	NS	NS	NS	NS	0.14	0.15	NS

Note: * Figure in parentheses' are transformed value $\sqrt{x + 0.5}$

DAS = Days after spraying of insecticides.

Table 4. Effect of insecticides on staphyllinid beetle population.

Treat. no.	Insecticides	Dose (ha)	After 1st spray					After 2nd spray				
			pre treat ment	post treatment				Pretreatm ent	post treatment			
				3 DAS	5 DAS	7 DAS	15 DAS		3 DAS	5 DAS	7 DAS	15 DAS
T1	Fipronil 5 SC	1000 ml	0.90 (1.18)*	0.70 (1.09)	0.60 (1.03)	0.45 (0.97)	0.85 (1.16)	1.05 (1.24)	0.35 (0.92)	0.55 (1.02)	0.85 (1.13)	0.95 (1.20)
T2	Emamectin Benzoate 5 SG	250 gm	1.00 (1.21)	1.10 (1.25)	0.65 (1.06)	0.75 (1.12)	0.90 (1.18)	0.85 (1.15)	0.50 (1.00)	0.95 (1.20)	0.70 (1.09)	1.15 (1.28)
T3	Profenophos 50 EC	750 ml	0.95 (1.20)	0.45 (0.97)	0.55 (1.02)	0.40 (0.95)	0.45 (0.94)	0.90 (1.17)	0.35 (0.92)	0.75 (1.12)	0.65 (1.06)	1.18 (1.26)
T4	Chlorpyriphos 20 EC	1250 ml	0.85 (1.16)	0.35 (0.92)	0.45 (0.97)	0.35 (0.92)	0.36 (0.93)	0.75 (1.11)	0.22 (0.84)	0.55 (1.00)	0.85 (1.16)	0.85 (1.15)
T5	Dimethoate 30 EC	850 ml	0.95 (1.20)	0.60 (1.04)	0.45 (0.97)	0.55 (1.02)	0.55 (1.02)	0.90 (1.18)	0.35 (0.92)	0.80 (1.13)	0.85 (1.15)	1.00 (1.22)
T6	Indoxacarb 15.8 EC	500 ml	0.85 (1.16)	0.40 (0.95)	0.60 (1.04)	0.55 (1.02)	0.50 (0.99)	0.80 (1.14)	0.30 (0.89)	0.85 (1.16)	0.80 (1.14)	1.00 (1.22)
T7	Metasystox 25 EC	750 ml	0.90 (1.18)	0.45 (0.97)	0.35 (0.92)	0.50 (1.00)	0.55 (1.02)	0.70 (1.09)	0.35 (0.92)	0.75 (1.12)	1.10 (1.26)	1.00 (1.22)
T8	Neem oil 1%	5000 ml	1.05 (1.24)	0.45 (0.97)	0.55 (1.02)	0.50 (1.00)	0.45 (0.97)	0.60 (1.03)	0.40 (0.94)	0.85 (1.16)	1.00 (1.21)	0.95 (1.20)
T9	Agroneem 1.5%	1250 ml	0.95 (1.20)	0.45 (0.96)	0.40 (0.95)	0.60. (1.04)	0.70 (1.12)	0.85 (1.15)	0.30 (0.89)	0.65 (1.07)	0.75 (1.11)	0.90 (1.18)
T10	NSKE 5%	12.50 lit.	1.00 (1.22)	0.50 (1.00)	0.60 (1.04)	0.60 (1.04)	0.60 (1.04)	0.85 (1.16)	0.30 (0.89)	0.85 (1.16)	0.65 (1.06)	0.90 (1.18)
T11	Control	-	1.00 (1.22)	1.30 (1.34)	0.85 (1.15)	0.95 (1.20)	0.94 (1.19)	0.85 (1.15)	0.55 (1.02)	1.05 (1.24)	1.05 (1.22)	0.95 (1.20)
SE(m)			**0.06**	**0.05**	**0.06**	**0.05**	**0.06**	**0.06**	**0.03**	**0.04**	**0.06**	**0.04**
C.D. at 5%			**NS**	**0.15**	**NS**	**0.13**	**NS**	**NS**	**0.09**	**0.11**	**NS**	**NS**

Note: * Figure in parentheses' are transformed value $\sqrt{x} + 0.5$
DAS = Days after spraying of insecticides.

Table 5. Effect of insecticides on spider population.

Treat. no.	Insecticides	Dose (ha)	After 1st spray					After 2nd spray				
			pre treat ment	post treatment				pre treat ment	post treatment			
				3 DAS	5 DAS	7 DAS	15 DAS		3 DAS	5 DAS	7 DAS	15 DAS
T1	Fipronil 5 SC	1000 ml	1.40 (1.38)*	0.70 (1.09)	0.55 (1.02)	0.50 (1.00)	0.45 (0.97)	1.15 (1.28)	0.55 (1.02)	0.90 (1.18)	0.95 (1.20)	1.0 (1.22)
T2	Emamectin Benzoate 5 SG	250 gm	1.35 (1.36)	0.85 (1.15)	0.47 (0.98)	0.60 (1.05)	0.70 (1.09)	0.80 (1.14)	0.65 (1.07)	0.85 (1.16)	0.85 (1.16)	1.15 (1.28)
T3	Profenophos 50 EC	750 ml	1.30 (1.34)	0.50 (1.00)	0.40 (0.95)	0.55 (1.02)	0.50 (0.99)	0.75 (1.11)	0.70 (1.09)	0.90 (1.18)	0.95 (1.20)	0.95 (1.20)
T4	Chlorpyriphos 20 EC	1250 ml	1.40 (1.37)	0.45 (0.97)	0.65 (1.07)	0.50 (0.99)	0.40 (0.95)	0.90 (1.18)	0.70 (1.09)	1.15 (1.28)	0.90 (1.18)	1.10 (1.26)
T5	Dimethoate 30 EC	850 ml	1.35 (1.36)	0.50 (1.00)	0.80 (1.13)	0.65 (1.07)	0.75 (1.11)	0.85 (1.16)	0.55 (1.02)	0.80 (1.14)	0.90 (1.18)	0.85 (1.16)
T6	Indoxacarb 15.8 EC	500 ml	1.30 (1.34)	0.60 (1.05)	0.47 (0.98)	0.35 (0.92)	0.70 (1.09)	0.90 (1.17)	0.65 (1.07)	0.85 (1.16)	0.80 (1.13)	1.00 (1.22)
T7	Metasystox 25 EC	750 ml	1.35 (1.36)	0.40 (0.95)	0.52 (1.01)	0.50 (1.00)	0.60 (1.04)	0.85 (1.15)	0.60 (1.05)	0.90 (1.18)	1.25 (1.32)	0.95 (1.20)
T8	Neem oil 1%	5000 ml	1.40 (1.37)	0.55 (1.02)	0.65 (1.07)	0.50 (0.99)	0.60 (1.04)	0.85 (1.16)	0.70 (1.09)	0.95 (1.20)	1.05 (1.24)	0.95 (1.20)
T9	Agroneem 1.5%	1250 ml	1.45 (1.39)	0.60 (1.04)	0.70 (1.09)	0.65 (1.07)	0.75 (1.11)	0.85 (1.160	0.60 (1.05)	0.90 (1.18)	0.95 (1.20)	0.90 (1.18)
T10	NSKE 5%	12.50 lit.	1.35 (1.35)	0.30 (0.89)	0.60 (1.04)	0.70 (1.09)	0.65 (1.07)	1.05 (1.24)	0.55 (1.02)	0.90 (1.18)	1.30 (1.34)	1.00 (1.22)
T11	Control	-	1.30 (1.34)	1.50 (1.41)	1.05 (1.24)	2.55 (1.56)	0.75 (1.11)	0.95 (1.20)	0.75 (1.12)	1.20 (1.30)	0.90 (1.18)	0.95 (1.20)
SE(m)			0.15	0.05	0.06	0.12	0.06	0.05	0.04	0.04	0.05	0.03
C.D. at 5%			NS	0.14	NS	NS	NS	NS	NS	NS	NS	NS

Note: * Figure in parentheses' are transformed value $\sqrt{x + 0.5}$
DAS = Days after spraying of insecticides.

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RESPONSE OF OKRA [*ABELMOSCHUS ESCULENTUS* (L.) MOENCH.] TO INTRA-ROW SPACING IN NORTHERN HILLS OF CHHATTISGARH

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Abstract: Field experiments were conducted *Kharif* season, during the years 2010 and 2011 planting seasons at the northern hills of Ambikapur Chhattisgarh, to evaluate the response of 'Arka Anamika' variety of okra to different intra-row spacing and to determine the optimal intra-row spacing that would maximize yield under northern hills conditions. The treatments consisted of three intra-row spacing (35 cm, 30 cm and 25 cm), replicated four times in a randomized complete block design. Results of the study showed that while the tallest okra height was produced from the intra-row spacing of 30 cm, the number of branches per plant, leaf area, pod length, pod diameter, number of pods per plant, pod weight and yield decreased as intra-row spacing reduced. The greatest yield was obtained from the intra-row spacing of 35 cm. The yield produced from the intra-row spacing of 35 cm was significantly ($P<0.05$) greater by 6.00 and 6.12 tone/ha respectively, in the year 2010 and 2011 compared to that obtained from the intra-row spacing of 30 cm and by 5.00 and 5.10 tone/ha respectively, in the year 2010 and 2011 compared to that produced from the intra-row spacing of 25 cm. The implication of this study showed that to maximize okra yield for variety 'Arka Anamika' the optimal intra-row spacing was found to be 35 cm and could therefore, be recommended for northern hills region of, Ambikapur C.G.

Keywords: Okra, Spacing, Yield, Variety

INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) is one of the most important vegetable crops in India covering an area of 3.58 lakh hectare with an annual production of about 35.25 lakh tones (FAO, 2013). In Chhattisgarh state, it is cultivated on an area of 2050 ha with an annual production of 28700 metric tons (Anonymous, 2013). In grown in tropical and subtropical parts of the world (Absar and Siddique, 1992). In India, it is among the foremost vegetable crops, in terms of consumption and production area (Iremiren and Okiy, 1999).

The immature pods are used as boiled vegetable while its dried form is used as soup thickner (Owonubi and Yayock, 1981). The green pods are rich sources of vitamins, calcium, potassium and other minerals (Lee *et al.*, 2000). It is popularly grown by farmers both for home use and source of income. There are several reasons for poor growth and yield of okra, among those, intra-row spacing play an important role (Yadev and Dhankhar, 2005).

The intra-row spacing for optimal okra seed yield as recommended by different authors ranged from 20 to 40 cm (Hossain *et al*., 2001 and Rastogi *et al*., 2001). Sing *et al*., (1996) reported a taller okra height when grown at a closer intra– row spacing of 30 cm than when grown at a wider intra–row spacing of 40 cm. Similarly, Ghanti *et al*., (1991) observed progressive yield decreases of up to 0.5 t/ha for each reduced intra–row spacing from 30 cm.

Yield decreases of 'Arka Anamika 'okra varieties attributable to reduced intra-row spacing have been reported by Iremiren and Okiy (1999). Similarly, Ezeakunne (2004) reported that the yield components of 'Arka Anamika'' okra variety, such as pod length, pod diameter, number of pods and pod weight were relatively higher in value at wider intra-row spacing of 35 and 30 cm than at reduced spacing. He attributed this to a greater assimilation of growth resources for the plants grown at the wider spacing.

MATERIAL AND METHOD

The experiment was conducted *Kharif* season, during the years 2010 and 2011 planting seasons, at the Research station RMDCARS Ambikapur (C.G.) to evaluate the response of 'Arka Anamika' variety of okra to different intra-row spacing. The 'Arka Anamika', an improved okra variety in terms of yield, shows wide adaptation to different growing environment (Usman, 2001). The experimental area (84.0 m²) which consisted of sandy–loam soil was cleared, ploughed, harrowed, ridged and divided into twelve plots. Each plot had an area of 7.0 m². The plot consisted of four ridges spaced 90 cm apart. The treatments constituted the three intra-row spacing (35 cm, 30 cm and 25 cm) respectively, for the 'Arka Anamika' okra variety. The treatments were arranged in a randomized complete block design (RCBD) and replicated four times. Okra seeds were sown in a hole to a depth of 2 cm, on top of the ridges using the intra–row spacing specified for each plot. Three seeds were sown per hole and later thinned to one plant at 2 weeks after planting (WAP). The plots were manually weeded as the need arose. Mixed fertilizer NPK 200,100,100 kg ha^{-1}. Was applied as described by Ekpete (2000), using the side placement method of fertilizer application. The fertilizer was applied as a split application to the trial at 3 and 6 WAP.

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Harvesting was done in late September when the tip of pod was observed to break easily when pressed with the finger tip (Usman, 2001).

Data taken included plant height at 50 % flowering, number of branches per plant, leaf area, pod length, pod diameter, number of pods per plant, pod weight and yield (t/ha). The data were subjected to Analysis of Variance (ANOVA) while the Least Significant Difference (LSD) was used to separate treatment means following the procedure of Steel and Torrie (1980) number of rainy days (Table 1). The average monthly temperature for the two years ranged from 25.1 °C to 33.2 °C, while the average relative humidity ranged from 78.0 % to 80.0 % for the two years (Table 1). The average monthly temperature and relative humidity range were considered optimal for the growth and development of okra. Katung (2007) reported optimum growth and development for okra at temperature of 32 °C while Ezeakunne (2004) observed an improvement in the performance of okra with the relative humidity range of 75 to 85 %. Similar results were reported by Yamaguchi (1983).

RESULT AND DISCUSSION

Rainfall occurred from the months of July to September for the two years of study. The month of July recorded the highest amount of rainfall and highest number of rainy days (Table 1). The average monthly temperature for the two years ranged from 30.72°C to 31.20°C, while the average relative humidity ranged from 78.0% to 82.0% for the two years (Table 1). The average monthly temperature and relative humidity range were considered optimal for the growth and development of okra. Katung (2007) reported optimum growth and development for okra at temperature of 32 °C while Ezeakunne (2004) observed an improvement in the performance of okra with the relative humidity range of 70 to 85 %. Similar results were reported by Yamaguchi (1983)

Table 1. Meteorological information for Ambikapur, CG. (July– September) 2010 and 2011.

Months	Average monthly rainfall (mm)	Average monthly temperature (^{0}C)		Average relative humidity (%)
2011		Maximum	Minimum	
July	208	30.72	30.72	78.0
August	160	30.80	30.82	80.0
September	177	28.32	28.30	80.0
2012				
July	226	32.22	32.20	73.0
August	170	29.40	29.4 0	77.0
September	180	31.20	31.20	79.0

The Physico–chemical property of the soil of the experimental site in the year 2010 and 2011 is given in Table 2. Total nitrogen value in the soil over the two years was low (2.58 %% and 2.60 %). Similarly, the soil had a medium level of phosphorus (5.2 ppm and 5.6 ppm) with a corresponding low level of potassium (0.22 % and 0.32 %) respectively, for the year 2010 and 2011. Relatively moderate amounts of exchangeable bases (Ca g) were present in all the soil units. Over the years, organic matter was low (2.50% and 2.60 %), while the pH in water was near neutral (Table 2). The growth and yield components of 'Arka Anamika' variety of okra as influenced by different intra-row spacing in Research station RMDCARS Ambikapur, in years 2010 and 2011 is presented in Table 3.

Table 2. Physico-chemical properties of the soil of the experimental site in the year 2010 and 2011.

Soil analytical data			
Parameters'	**2010**	**2011**	**Method of analysis**
Organic matter	2.5 %	2 .6%	Walkley-Black method
Nitrogen	2.58 %	2.60 %	Alkaline Permanganate Method (Subbiah and Asija, 1956)
P_2O_5	5.2 ppm	5.6 ppm	Olsen's Method (Olsen, 1954)
K	0.22%	0.32 %	Flame Photometric Method (Jackson, 1967)
Ca	2.98meq/100g	4.66meq/100g	A. A. S
pH (H_2O)	6.8	6.4	pH meter
pH ($Cacl_2$)	5.9	5.4	pH meter

ppm: parts per million

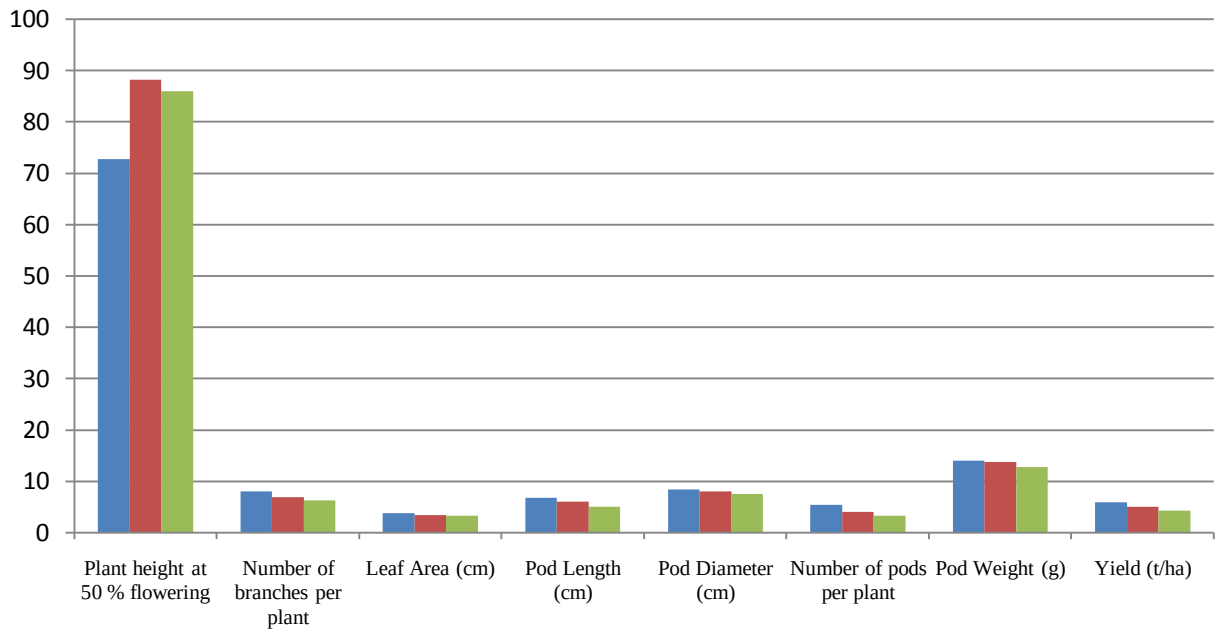
A.A.S.: Atomic Absorption Spectrophotometer

Table 3. Growth and yield components of 'Arka Anamika' variety of okra as influenced by different intra–row spacing in RMDCARS Ambikapur, in years 2010 and 2011.

	Plant height at 50 % flowering (cm)		Number of branches per plant		Leaf Area (cm)		Pod Length (cm)		Pod Diameter (cm)		Number of pods per plant		Pod Weight (g)		Yield (t/ha)	
Intra-row spacing	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
35 cm	86.22	72.85	8.96	8.10	406.10	388.12	8.55	6.90	8.10	8.50	7.10	5.50	15.10	14.10	6.10	6.00
30 cm	92.12	88.33	7.66	6.94	388.14	350.55	8.10	6.12	7.80	8.10	6.50	4.10	13.36	13.90	5.00	5.10
25 cm	91.55	85.98	6.98	6.35	365.98	338.98	6.92	5.10	7.20	7.60	5.60	3.38	12.90	12.90	4.50	4.40
mean	89.96	82.38	7.86	7.13	386.72	359.21	7.85	6.04	7.70	8.06	6.40	4.46	13.78	13.46	5.20	5.16
LSD	4.46	5.52	0.62	66.35	16.30	11.70	5.72	4.12	3.92	3.98	2.98	2.90	1.12	0.22	1.00	0.28
(P=0.05) CV (%)	13.12	9.98	19.12	713.32	7.80	8.62	10.80	19.10	6.56	5.72	11.12	15.56	15.20	16.20	5.20	6.72

fig 1: Growth and yield components of 'Arka Anamika' variety of okra as influenced by different intra–row spacing in RMDCARS Ambikapur, in years 2010

fig 2: Growth and yield components of 'Arka Anamika' variety of okra as influenced by different intra–row spacing in RMDCARS Ambikapur, in years 2011



The tallest okra height was produced from the intra-row spacing of 30 cm, which was significantly ($P<0.05$) greater than that produced from the wider intra-row spacing of 35 cm. However, plant height obtained from the intra-row spacing of 30 cm and that recorded for 25 cm showed no significant difference (Table 3). The taller plants obtained from the intra-row spacing of 30 cm and 25 cm over the years might be attributed to the competition for light and other growth resources among the crops that were crowded at the closer intra-row spacing, thereby resulting in the production of taller plants. This result supports Sing *et al*., (1996) who reported a greater okra height when grown at closer intra- row spacing of 30 cm than when grown at a wider intra–row spacing of 40 cm. Hossain *et al*., (2001) also reported greater plant height from closer intra-row spacing than from wider intra-row spacing. Similar results were obtained by Gorachand *et al*., (1990) and Randhawa and Pannum (2000).

The number of branches per plant and leaf area decreased as intra-row spacing reduced. Over the years, the greatest branch number and largest leaf area were obtained from the intra-row spacing of 35 cm, which were significantly ($P<0.05$) greater than those produced at reduced intra-row spacing of 30 cm and 25 cm respectively. The reduced competition for light and reduced overlapping from adjacent okra plants within the ridge could have enabled the plants grown at the intra-row spacing of 35 cm to utilize its energy for maximum branching and subsequently, the production of a larger leaf area. This result was similar to the findings of Saha *et al*., (2005) who reported a greater branch number at wider intra- row spacing of 40 cm compared to that produced from a reduced intra–row spacing of 25 cm.

The pod length and pod diameter of okra were not significantly affected by the three intra-row spacing employed. This result contradicted those of Moniruzzaman *et al*., (2007) where pod length and pod diameter significantly reduced at closer intra-row spacing. These conflicting results might be due to the difference in the environmental pattern of the study locations and to the variation in the genetic potential of the variety used.

The number of pods per plant decreased as intra-row spacing reduced. The intra-row spacing of 30 cm produced the greatest number of pods per plant. The number of pods produced from the intra-row spacing of 35 cm was significantly ($P<0.05$) greater by 7.10 and 5.50 plant^{-1} respectively, in 2010 and 2011compared to that obtained from the intra-row spacing of 30 cm and by 6.50 and 4.10 plant^{-1} respectively, in 2010 and 2011compared to that obtained from the intra-row spacing of 25 cm. The greatest number of branches per plant obtained from the intra-row spacing of 30 cm might have also contributed to its greatest number of pods produced.

The greatest pod weight and yield were obtained from the intra-row spacing of 30 cm. Plants grown at the wider intra-row spacing might have received more nutrition and light for optimal growth and development, thereby producing the greatest pod weight and yield. Similarly, the largest leaf area

produced from the intra-row spacing of 35 cm might have also accounted for its greatest pod weight and yield. The yield produced from the intra-row spacing of 35 cm was significantly ($P<0.05$) greater by 15.10 and 14.10 gm respectively, in 2010 and 2011compared to that obtained from the intra-row spacing of 30 cm and by 13.36 and 13.90 gm respectively, in 2010 and 2011compared to that produced from the intra-row spacing of 25 cm. This result was similar to the findings of Hossain *et al*., (2001), but contradicted those of Gorachand *et al*., (1990) and Ghanti *et al*., (1991) where maximum okra yield was obtained from closer intra–row spacing of 25 cm. The conflicting results might also be due to the variation in the environment and differences in the genetic potential of the varieties used.

CONCLUSION

From the results obtained, it can be concluded that in RMDCARS Ambikapur, in years 2010 and 2011which, the optimal intra-row spacing for 'Arka Anamika 'okra variety was found to be 35 cm. This is associated with a greater number of branches per plant, leaf area, pod length, pod diameter, number of pods per plant, pod weight and yield respectively. It is however, recommended that further investigation of study be evaluated across a wider combination of okra varieties and across different locations within the northern hills of Chhattisgarh.

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A STUDY OF MORPHOLOGICAL VARIATIONS IN OTOLITHS OF DIFFERENT SPECIES OF *LABEO* ON THE BASIS OF GROWTH AND GENDER

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Abstract: A study was carried out to study the sexual and ecological age growth variations in the morphology of otoliths (sagitta) among various native species of the genus *Labeo* from Meerut region viz. *Labeoangra, Labeocalbasu, Labeogonius*and*Labeorohita.* The data obtained was photographed and statistically analysed. From the studies of saggitta of the four species of *Labeo* collected, it is clearly evident that otoliths (sagitta) are species specific in shape, size and structure. Based on the results of morphometric variations the Otoliths of the four species of *Labeo*, showed no significant differences between right & left sagitta ($P<0.05$). The lack of significant differences between right & left sagittae is consistent with the observation that the pair of Otoliths are specular images of each other. Noticeable differences were observed among the four species in otolith morphometric variables.

Keywords: *Labeo* sp., Otololith, Sagittae, Morphometry, Growth, Gender

INTRODUCTION

Each individual fish species possesses three pairs of otoliths in the inner ear viz, Sagitta, Lapillus and Asteriscus, the largest of which are the sagittae. The sagittae are the most variable between species. The otoliths are composed primarily of aragonite. They also contain 0.7 to 10% organic matter in the form of a protein known as otolin. The structure of the otoliths (Sagitta) is three dimensional but they do not necessarily grow at the same rate equally in all dimensions. Otoliths of each species have characteristic, shape and feature. For this reason otoliths are widely used in the systematic research of the teleost fishes. Morphology and morphometries of sagittae have been used in trophic studies and in identification of populations or species (Botha, 1971; Messieh, 1972; Beamish, 1979; Yefanov and Khorevin, 1979) and to determine ages. The shapes and proportional sizes of the otoliths vary with fish species. Otoliths is the only calcified structures that grows throughout the life of fish, are metabolically inert and are typically available as historical time series because of routine age and growth assessments. The otolith radius is significantly related to fish body size (e.g. fork length) and daily increment accumulating in periods of faster growth (Neilson and Geen, 1987; Campana and Neilson, 1985; Breadford and Green, 1987; Campana 1990). One of the most appreciated characteristics of the otoliths is the lack of resorption. After the death and decomposition of a fish, otoliths and statoconia may be preserved within the body of an organism or be dispersed before burial and fossilization. Dispersed otoliths are one of the many microfossils which can be found through a micropalaeontological analysis of a fine sediment. Otolith have been used for taxonomy, age, growth and population studies. Besides age and growth determination, otolith have been the objects of study in many different fields, such as fish biology, larval fish ecology, species identification, fish stock identification and environmental reconstruction of the fish habitat. Otoliths have a distinctive shape which is highly species specific, but varies widely among species.

Labeo species (Carps) belonging to family: Cyprinidae, are well adapted for pisciculture, as they grow to a large size and all have food value. They can live in almost any condition. It is an herbivore and is treated as a delicacy in Orissa, Bihar and Uttar Pradesh. It is relished very much in food and rich in protein content. Carps are cultivated in specially constructed water ponds, having adjacent breeding areas. Mostly cultivated with *Catla* in fresh water ponds & lakes in the absence of carnivorous fish. It is also used as a game fish where it is specially introduced into water reservoirs for the purpose of sport fishing.

According to Jayaram (1981), several species of *Labeo* has been reported from India so far. Out of which available in Meerut region are: *Labeoangra* (Hamilton, 1822) *Labeocalbasu* (Hamilton, 1822) *Labeogonius* (Hamilton, 1822) *Labeorohita* (Hamilton, 1822)

The aim of the present study was to find out sexual and ecological age to growth variations in the morphology of sagitta among various species of the genus *Labeo* (Cuvier) from Meerut region. The data so obtained was photographed and statistically analyzed.

MATERIAL AND METHOD

For the present investigation fishes were obtained from the local fish market or from various water bodies and fish farms in and around Meerut and

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Hastinapur region with the help of fisherman. Fish specimens were collected during the period 2009-2014. Morphologically all the four species of genus Labeo were identified using Day's fauna (1878) and Jayaram (1981). In the present study, more than 100 specimens belonging to both sexes of each species of Labeo were observed. Sagittae (largest of three otoliths) from both sides were taken out and 30 best formed sagittae were studied in detail for its morphology and morphometry i.e. length, width and weight (mass). Length and width of otoliths were measured with the help ofImage pro plus ver.6.1 software. Otolith mass was measured by using Microbalance. Light microscopy was performed to observe morphological characters. Total length (TL; in centimeter i.e. most anterior point to the posterior tip of the caudal fin) was considered and measured to the nearest millimeter and body weight (TW in grams) was recorded prior to the removal of otoliths.

The otoliths (Sagitta) were removed as soon as the fish was sacrificed. A frontal head cut at the level of the top of the eye was established for the removal of sagittal otoliths (Brothers, 1987). Then, the otoliths were cleaned in the water container and observed under a binocular microscope prior to grinding. Each dried otolith was stored in a plastic vials. The date and identification number were labeled on the plastic vials. The otoliths were stored in such a way as to ensure they occupy the minimum space and are well-preserved and easy to identify. Otoliths were stored in vials, dry ready for use immediately. Growth structures are more easily visible in newly collected otoliths. They were therefore read as quickly as possible.

Preparation for Examination

The cleaned otoliths were kept in 70% ethanol for two to three hours and were allowed to dry for a while. The otoliths were fixed with the convex side up showed rings more clearly than those mounted with the concave side down. Otoliths were ground and polished to improve clarity of the rings for seasonal growth increments. The otoliths were ground on the sandpaper no. 0 and polished with Silicon carbide.

Otolith Reading

Otolith microstructures were read under a transmitted and reflected light microscope with 100x, magnifications. The rings were counted from the nucleus towards the posterior edge of the otolith. The oil immersion (Cedar wood oil) was dropped in the otolith centered the slide in order to increase the visibility of the micro increments. Length and width of otoliths were measured with the help of Image Pro-Plus version 6.1 software.

The polished otoliths were washed in water and dried under a gentle heat source such as a lamp or moderate oven (60°C) and mounted on a slide and photographed under Stereo microscope.

Statistical Analysis

The relationship between fish size (TL), otolith size (length and width) and fish Weight (TW) and otolith mass (OM) were determined using least squares linear regression for the following parameters: fish length (TL)- Otolith lengh (OL), fish length (FL)- Otolith width (OW) and fish weight (TW)- Otolith mass (OM).The regression coefficients were compared and when significant differences (P<O.05) were calculated, If the equations did not differ statistically, a single linear regression was reported for each parameter. The significance of the Linear regressions were verified using F-test. Fishers' variance test was applied for comparing the slopes of the estimated relations for males and females of *Labeosps. (Labeoangra, Labeocalbasu ,Labeogonius , Labeorohita).* Linear regressions were obtained for each sex to investigate possible sexual differences.

An ANCOVA was performed separately for each species to test if the slopes of the fish length to Otolith length and width; fish weight to Otolith mass depended on sex and to observe interspecific variations in the morphological parameters. (Dependent variables for the study were Otolith length, Otolith width and Otolith mass).

RESULT AND DISCUSSION

The study revealed that both the right and left otoliths were almost identical and no sexual differences were also observed in all the four species studied.

In *Labeoangra,* the dorsal margin is smoother and ventral has a depression below the antirostrum, in both the sexes. Notch separating rostrum from antirostrum is straight Ostium and Cauda are tubular and directed upwards or dorsally. Anterior end is pointed and posterior end is rounded. In *L. calbasu, the* dorsal margin is wavy and irregular and ventral margin with depression below the antirostrum. Notch between rostrum and antirostrum is well defined. Ostium and Cauda are tubular and straight. Anterior end more pointed and posterior end irregular.

In the case of *L. gonius,*sagitta is more wide as compared to its length. Dorsal margin is wavy and ventral margin has a depression below the antirostrum. Notch separating rostrum from antirostrum is deep and well-marked. Ostium and cauda arestructurally similar to that of other *Labeo* species. Dorsal margin in is smooth or slightly wavy, ventral margin with a depression near the antrirostrum in *L.rohita.* Rostrum and antirosturm is well marked.

From the above observations on sagitta of the four species of Labeo collected from Meerut region, it is clearly evident that otoliths (sagitta) are species specific in shape, size and structure. (Harvey *et al*; 2000, Battaglia*et al*., 2010).

Noticeable differences were observed among the four species in otolith morphometric variables.

Table: 1 clearly indicate that Otolith length (OL) and Otolith width (OW) varies with Total Fish Length (FL) and Otolith mass (OM) with the Fish weight.

In *L.angra* otolith length is 0.61 % in male and 0.63%in female of the total fish length. In *L.calbasu* otolith length is 0.41 % in male and in female 0.40%, of the total fish length. In *L.gonius*and *L.rohita*, the otolith length is 0.65% and 0.71 % in male and 0.66% & 0.71in female of the total fish length, respectively. This indicates that *L.rohita* showed the largest otolith both in male and female followed by *L. gonius* and *L. angra.* The smallest and the lightest otoliths were observed in *L.calbasu.*These results are in accordance with the observations of many scientists that the morphometry of the sagittae and otoliths in fishes are species specific. (Platt and Popper, 1981 Gauldie, 1988). There are very few descriptions of sex-specific growth effect (Ahmad &Alghais, 1997, Munday*et al.*, 2004). Several studies demonstrate that Otolith growth is more closely associated to time than fish size. (Munday*et al.*, 2004; Fey 2006).

In contrast, if a growth effect was present, females would be expected to have relatively smaller otoliths than males because somatic growth is higher in females. This fact may depend on the interaction of genetic, endocrinological and environmental conditions with somatic growth (Fey, 2006). Although, the size of the fish and Otolith size are correlated, Otolith size tends to be somewhat more correlated with fish age than fish length. (Templeman and Squises 1956, Boehlert 1985). Various studies have been done in the past, which generally focused on the relationship between size of fish and sagitta. (Wylie, 1987; Gamboa 1991; Garanaderio and Silva 2000; Harvey *et al.*, 2000; Waessle*et al.*, 2003 and Battaglia*et al.*, 2010).

Table 1. Showing range and mean of fish length, fish weight, otolith length, otolith width and otolith mass of the species studied.

Fish Species	Gender	FL (cm)	FM (gm)	OL (mm)	OW (mg)	OM (mgm)	Percentage		
							OL/TL	OW/TL	OM/FM
Labeoangra	**Male**	24-29	128-144	1.56-1.67	1.12-1.28	0.04-0.08	0.61	0.43	0.40
	Female	22-26	120-130	1.33-1.57	1.09-1.28	0.04-0.08	0.63	0.48	0.43
Labeocalbasu	**Male**	24-34	160-180	1.10-1.24	0.72-0.90	0.02-0.05	0.41	0.29	0.20
	Female	24-34	160-180	1.10-1.26	0.74-0.88	0.02-0.05	0.40	0.28	0.20
Labeogonius	**Male**	26-32	450-600	1.85-1.95	1.26-1.40	0.03-0.05	0.65	0.45	0.071
	Female	26-32	450-600	1.89-1.97	1.26-1.44	0.03-0.05	0.66	0.43	0.073
Labeorohita	**Male**	21.5-30.	110-140	1.68-1.83	1.24-1.49	0.04-0.08	0.71	0.56	0.38
	Female	21.8-30.5	105-140	1.66-1.87	1.28-1.50	0.03-0.08	0.73	0.56	0.37

Actually, Otolith size can be better used to interpret fish age than fish length.The interspecific variations in shape and size of the Otolith of *Labeo* species are also reported in the present study. The topography of the inner surface i.e shape of Ostium, width of cauda and type of depression in the dorsal area and ventral was the most variable feature as also exemplified in sciaenid fishes (Chao, 1978; Ramcharitar*et al.*2004; Pawan Kumar *et al.*, 2012). The results of the present investigation, provide useful information on Total length vs Otolith length, Fish Length vs Otolith Width, Fish mass/weight vs Otolith Mass relationships for the *Labeo* species.

The analysis of the morphometric parameters using paired student's t- test, showed no significant differences between the right and left sagittae in both males and females. Since the morphological and morphometric characters of the left and right otoliths did not differ statistically, anyone of them (preferably right otoliths) were selected randomly for each individual of all the four species and simple linear regression was performed for each species for establishing relationship between Total Fish length with Otolith length and otolith width; Fish weight or mass with Otolith mass. The regression slopes for the measures of the sagittae of male and female showed no significant differences when comparing them with Fishers test. The parameters compared with Total fish length (TL) were Otolith Length (OL) and Otolith Width(OW); Fish weight (FW) with Otolith mass (OM). Morphometric relationships among the characters compared were established using simple linear regression model which bests fits the data distribution. The appropriateness of the linear model was determined by plotting the residuals against the independent variables.

The relationship between Fish total length and otolith morphometric measurements COL: OW) is linear and most of the variability is explained by regression equation. These calculations based on morphometric parameters were subjected to Fishers Variance test and ANCOVA test to evaluate Interspecific Variations which are given in Tables1-3.

Table 1. Ancova test inter specific variation in labeo species: combined analysis between fish length & otolith length

Species* Gender
Dependent Variable: OTOLITH LENGTH

Species	Gender	Mean	Std. Deviation	N
La	Male	1.6300	.02573	30
	Female	1.5240	.06234	30
	Total	1.5770	.07136	60
Lc	Male	1.1667	.03968	30
	Female	1.1690	.04071	30
	Total	1.1678	03988	60
Lg	Male	1.8973	.04748	30
	Female	1.9057	.03451	30
	Total	1.9015	.04137	60
Lr	Male	1.7177	.18281	30
	Female	1.7613	.04257	30
	Total	1.7395	.13342	60
Total	**Male**	**1.6029**	**.28736**	**120**
	Female	**1.5900**	**.28532**	**120**
	Total	**1.5965**	**.28492**	**240**

Levene's Test of Equality of Error Variances*
Dependent Variable: OTOLITH LENGTH

F	dfI	Df3	Sig
7.309	.8	231	.000

Test the null hypothesis that the error variance of the dependent variable is equal across groups a Design. FISH LENGTH + Species + Species* Gender

Test of Between – Subject Effects
Dependent Variable: OTOLITH LENGTH

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	18.192a	8	2.274	434.246	.000
FISH LENGTH	.138	1	.138	26.269	.000
Species	17.928	3	5.976	1141.174	.000
Gender	.003	1	.003	496	.000
Species* Gender	.115	3	.38	7.309	.000
Error	1.210	231	.005		
Total	**19.402**	**240**			

a. R Squared = .938 (Adjusted R Squared =.935)

1. Species

Dependent Variable: OTOLITH LENGTH Dependent

Species	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
La	1.592[a]	.010	1.572	1.611
Lc	1.149[a]	.010	1.129	1.169
Lg	1.878[a]	.010	1.857	1.898
Lr	1.767[a]	.010	1.746	1.789

Covariates appearing in the model are evaluated at the following values : FISH LENGTH = 26.7200

2. Gender

Variable: OTOLITH LENGT

Gender	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Male	1.600 [a]	.007 [a]	1.580	1.606
Female	.402 [a]	402 [a]	1.587	1.613

Covariates appearing in the model are evaluated at the following values : FISH LENGTH = 26.720

Table 2. ANCOVA TEST INTER SPECIFIC VARIATION IN LABEO SPECIES: Combined Analysis between fish Length & Otolith Length

Species* Gender
Dependent Variable: OTOLITH LENGTH

Species	Gender	Mean	Std. Deviation	N
La	Male	1.5187	.04023	30
	Female	1.1727	.07148	30
	Total	1.1657	.05794	60
Lc	Male	1.1727	07148	30
	Female	.8240	.06072	30
	Total	.8260	.06071	60
Lg	Male	1.3383	.05292	30
	Female	1.3340	.06083	30
	Total	1.3362	.05657	60
Lr	Male	1.3597	.05430	30
	Female	1.3553	.05917	30
	Total	.3575	.05635	60
Total	**Male**	**1.1702**	**.22163**	**120**
	Female	**1.1725**	**.22102**	**120**
	Total	**1.1713**	**.22086**	**240**

Levene's Test of Equality of Error Variances*
Dependent Variable: OTOLITH WIDTH

F	dfI	Df3	Sig
6.250	.7	233	.000

Test the null hypothesis that the error variance of the dependent variable is equal across groups a Design. FISH LENGTH + Species + Gender+ Species* Gender

Test of Between – Subject Effects
Dependent Variable: OTOLITH LENGTH

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	11.1430	8	1.393	623.699	.000
FISH LENGTH	.272	1	.272	121.820	.000
Species	10.862	3	3.621	1621.260	.000
Gender	.007	1	.007	3.295	.000
Species* Gender	.031	3	.010	4.681	.000
Error	566	231	.002		
Total	**11.659**	**240**			

a. R Squared = .938 (Adjusted R Squared =.935)

1. Species

Dependent Variable :OTOLITH LENGTH Dependent

Gender	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Male	1.177 [a]	.004	1.168	1.185
Female	1.166 [a]	.004	1.57	1.174

Covariates appearing in the model are evaluated at the following values: FISH LENGTH = 26.7200

2. Gender

Variable :OTOLITH LENGTH

Species	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
La	1.186	.007	1.174	1.199
Lc	1.800	.007	.787	.813
Lg	1.303	.007	1.289	1.316
Lr	1.397	.007	1.383	1.411

Covariates appearing in the model are evaluated at the following values : FISH LENGTH = 26.7200

3. Species* Gender

Dependent Variable:OTOLITH LENGTH

Species	Gender	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
La	Male	1.160a	.004	1.1143	1.177
	Female	1.212a	.009	1.194	1.230
Lc	Male	.799a	.009	.781	.816
	Female	.801a	.009	.783	.818
Lg	Male	1.305a	.009	1.287	1.319
	Female	1.300a	.009	1.282	1.323
Lr	Male	1.399a	.009	1.381	1.417
	Female	1.394a	.009	1.376	1.413

Covariates appearing in the model are evaluated at the following values : FISH LENGTH = 26.7200

Table 3. ANCOVA TEST INTER SPECIFIC VARIATION IN LABEO SPECIES: Combined Analysis between fish Length & Otolith Length

Descriptive Statistics

Dependent Variable: OTOLITH LENGTH

Species	Gender	Mean	Std. Deviation	N
La	Male	.0550	.01480	30
	Female	.543	.01633	30
	Total	.0547	.01546	60
Lc	Male	.0350	.00938	30
	Female	.0353	.00937	30
	Total	.0352	.00930	60
Lg	Male	.0387	.00730	30
	Female	.0387	.00730	30
	Total	.0387	.00724	60
Lr	Male	.0460	.01163	30
	Female	.0460	.01163	30
	Total	0460	.01153	60
Total	**Male**	**.0437**	**.01341**	**120**
	Female	**.0450**	**.01365**	**120**
	Total	**.0436**	**.01350**	**240**

Levene's Test of Equality of Error Variances*

Dependent Variable : OTOLITH WIDTH

F	dfI	Df3	Sig
6.652	.7	232	.000

Test the null hypothesis that the error variance of the dependent variable is equal across groups a Design. FISH LENGTH + Species + Gender+ Species* Gender

Test of Between – Subject Effects

Dependent Variable: OTOLITH LENGTH

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	.0310	8	.002	12.957	.000
FISH LENGTH	5.8266	1	.005	.448	.000
Species	.011	1	.004	27.760	.000
Gender	1.230	1	1.2308	.001	.002
Species* Gender	5.572E	3	1.857E	.014	.002
Error	030	231	.000		
Total	.500	**240**			

a. R Squared = .310 (Adjusted R Squared =.286)

1. Species

Dependent Variable: OTOLITH LENGTH

Species	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
La	.056a	.003	.051	.62
Lc	.036a	.002	.032	.040

Lg	.034a	.007	.22	.047
Lr	.048a	.003	.042	.50

a. Covariates appearing in the model are evaluated at the following values: FISH WEIGHT = 238.003**3.**

Species* Gender

Dependent Variable: OTOLITH LENGTH

Species	Gender	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
La	Male	0.56a	.003	0.30	0.63
	Female	0.56a	.003	.050	.062
Lc	Male	.036a	.003	.031	.041
	Female	.036a	.003	.031	.041
Lg	Male	034a	.007	.021	.048
	Female	.0340a	.007	0.21	.048
Lr	Male	0048a	.007	.041	.054
	Female	.048a	.007	.041	.054

a. Covariates appearing in the model are evaluated at the following values: FISH WEIGHT = 238.003

All the four species were put to Fishers variance test and ANCOVA which clearly indicates high interspecific variability in Shape, Size and weight of all the four species studied.

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BIONOMICS OF PREDATORY RED STINK BUG, *EUTHYRHYNCHUS FLORIDANUS* LINNAEUS (HEMIPTERA: PENTATOMIDAE) ON TURMERIC LEAF SKIPPER BUTTERFLY, *UDASPES FOLUS* AT RAIPUR (C.G.)

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Abstract: Studies on the biology of predatory red stink bug, *Euthyrhynchus floridanus* Linnaeus (Hemiptera: Pentatomidae on Turmeric, *Curcuma longa* L. conducted under laboratory conditions at Raipur Chhattisgarh, revealed that the bug, *E.floridanus* was found predating on the larvae of *Udaspes folus* and observed to be an extremely beneficial insect which killed their prey by sucking the body contents through a long, stout proboscis. the eggs were laid on upper surface of leaves. The eggs were laid in cluster with 68-70 per cluster and about 80 % eggs hatchability. Eggs were hatched 2 to 3 days after egg laid. The 1st instar nymph was approximately 1.0 mm long along with a blue-black head and thorax with red abdomen having dark central and lateral "stripes" composed of dorsal and lateral dark colored plates. The first instar nymphs were lived in groups or masses but later instar lived in individually because later instar cannibalism was observed. The 5th instar nymph was medium sized , approximately 1.2 to 1.5 cm in length. It was mottled brown or grey in colour and could easily be recognised by the presence of sharp spines on either side of the thorax. Nymph passed through 5 instars in about 30 to 38 days. Their total life cycle took about 39-50 days. Population of *E. floridanus* observed maximum during the month of November last week, which was recorded to be 0.063 bug per plant and minimum population recorded to be 0.026 bug per plant during the month of December second week.

Keywords: Red stink bug, Eggs, Nymphs, Adults, Population

INTRODUCTION

The present studies on insect pests of Agro-forestry system included karanja, *Pongamia pinnata* L. Pierre with intercropping of paddy, *Oryza sativa* var. mahamaya and multi-tier agro-forestry system consisting of Mangium (*Acacia mangium*), Aonla (*Emblica officinalis*), Meetha neem (*Murraya koenigii*) and turmeric (*Curcuma longa*) as the herbal layer. Aonla (*Emblica officinalis*) forming a layer with meetha neem (*Murraya koenigii*), as the middle layer and Mangium (*Acacia mangium*) forming the top most layer.

Turmeric, *Curcuma longa* is a flowering perennial that belonging to the *Zingiberaceae* or ginger family. It was found mainly infested by turmeric leaf roller skipper butterfly, *Udaspes folus.* The other insects found associated were shoot borers, grasshopper and predatory stink bug. In *Turmeric, C. longa*, only two insect pest was observed causing maximum damage and that was turmeric skipper butterfly, *U. folus and* grasshopper (unidentified). The other insects, which were recorded the natural enemies like red stink bug; *Euthyrhynchus floridanus* on larvae of *U. folus* its as a major predator.

The predatory stink bug, *E. floridanus* L., is considered a beneficial insect because most of its prey consists of plant damaging bugs, beetles, and caterpillars. It seldom plays more than a minor role in the natural control of insects in Florida, but its prey includes a number of economically important species. (Mead, 1976).

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MATERIAL AND METHOD

The present studies on the biology of predatory red stink bug, *E. floridanus* L. was conducted under lab conditions during October to November 2013. Immature stages *viz.* eggs and nymphs were collected from the field of agro-forestry, IGKV, Raipur and brought to the laboratory department of Entomology, IGKV, Raipur (C.G.) and kept in petridish, along with 4rd and 5th instar larvae of *U. folus* Cramer was provided daily. Nymphs were checked regularly for the exuviate to ensure moulting. Details of various stages up to adult emergence and their dimensions were recorded. Studied the population dynamics of *E. floridanus*, turmeric; *C. longa* was planted in 16 rows in the experimental field of multitier agro-forestry system, each row had about 50 plants. Observations were recorded on the various types and number of insect pests and their related natural enemies at weekly intervals.

RESULT AND DISCUSSION

Studies on the biology of the Red stink bug, *E. floridanus* was conducted on turmeric Leaf skipper butterfly, *U. folus* under laboratory conditions during December to January , 2013-14 at the department of Entomology, College of Agriculture, IGKV, Raipur.

Predating behavior

The bug was observed predating on the larvae of *U. folus* and noticed to be an extremely beneficial insect. They killed their prey by sucking the body contents through a long, stout proboscis (or beak). Once a bug detects a caterpillar of *U. folus* it extends its proboscis and inserts it into the body of caterpillar for sucking the body fluid.

Life history stages

1) **Eggs:** The females laid eggs in masses on the upper surface of leaves. Eggs of *E. floridanus* were approximately 1 mm in diameter, with short projections around the operculum, barrel shaped and laid in cluster about 68-70 eggs at a time.
2) **Nymphs :** Nymph passed through 5 instars in about 30-38 days. Mead (2000), similarly noticed that the identification of the nymphs is less certain, particularly the earlier instars. The available keys are based on the last instar (5th), but key characters often apply to the 4th instar as well. De Coursey and Allen (1968) published a key to the 5th instar nymphs of 25 genera of eastern U.S. stink bugs.

   1st instar : The 1st instar was approximately 1.0 mm long. Nymphs had a blue-black head and thorax with red abdomen having dark central and lateral "stripes" composed of dorsal and lateral dark colored plates. Predatory activity began from the 1st instar stage and captured the larvae of *Udaspes folus* as prey. It was observed during the studies that the 1st instar nymph could kill four larvae of *U. folus*. This period lasted for 2-3 days

   2nd instar : The 2nd instar was 1.5 to 1.8 mm long. Colouration of nymphs were similar to 1st instar and a total six larvae were consumed by 2nd instar nymphs. This period lasted for 3-4 days

   3rd instar : The 3rd instar nymph was approximately 3-5 mm long and it could consume about nine larvae. This period lasted for 3-4 days

   4th instar : The 4th instar was 7.0 to 9.0 mm long, could consume 19 larvae.This period lasted for 4-5 days.

   5th instar (Adult) : The 5th instar nymph was medium sized , approximately 1.2 to 1.5 cm in length. It was mottled brown/grey in colour and could easily be recognised by the presence of sharp spines on either side of the thorax. Females were larger than males. Total 25 larvae were consumed by 5th instar nymph (Adult). This period lasted for 18-22 days. In field condition we had seen 1st instar nymphs were lived in groups or masses but later instar lived in individually because later instar cannibalism was observed.

The mature nymphs reared by Oetting and Yonke (1975) size were recorded 10 to 12.5 mm in length. An occasional mistake of beginners is to confuse *Euthyrhynchus* nymphs with beetles. The latter would have elytra forming a suture dorsally, and the mouthparts would be of the chewing type. Also, the young stink bugs lack wings and have tubelike piercing sucking mouthparts.

E. floridanus has been reared in the laboratory by Ables (1975), Oetting and Yonke (1975), and Richman and Whitcomb (1978). At 26 to 27ºC, and with a photoperiod of 14:10, both Ables (1975) and Richman and Whitcomb (1978) found that the length of time from egg to adult was 58 days. The egg stage lasted 18 to 19 days.

Table 1. Showing details of the various development stages of the predatory red stink bug, *Euthyrhynchus floridanus* Linnaeus on turmeric leaf roller skipper butterfly, *U.folus*

S.N.	Development stage		Approximate Date	Total duration (days)	Body length (m.m.)	No. alive at beginning	No. dying	% mortality
1.	*Eggs laid*		*15-10-2014*	-	-	68	13	19.1
2.	Eggs hatching		24-10-2014	9-12	-	55	0	0.0
	Hatchability % = 80.88%							
3.	Nymphal stage	1st instar	24-10-2014	2-3	1.0-1.3	55	21	61.7
		2nd instar	27-10-2014	3-4	1.5-1.8	34	2	6.2
		3rd instar	30-10-2014	3-4	3.0-5.0	32	5	18.5
		4th instar	03-11-2014	4-5	7.0-9.0	27	4	17.3
		5thinstar Full grown adult	25-11-2014	18-22	12.0-15.0	23	0	0.0
Total	Total life cycle		Between 22-10-2014 to 25-10-2014 and lasted about 39-50 days					

g) Adult female and male bug

After 8-10 days

After 2-3 days

f) Just after moulting

a) Eggs mass

Plate no.1 : Life cycle of the Predatory red stink bug, *E. floridanus*, photograph by C.M. Sahu, IGKV, Raipur (C.G.)

After 2-3 days

e) 4th instar nymph

b) 1st instar nymphs

After 3-4 days

After 4-5 days

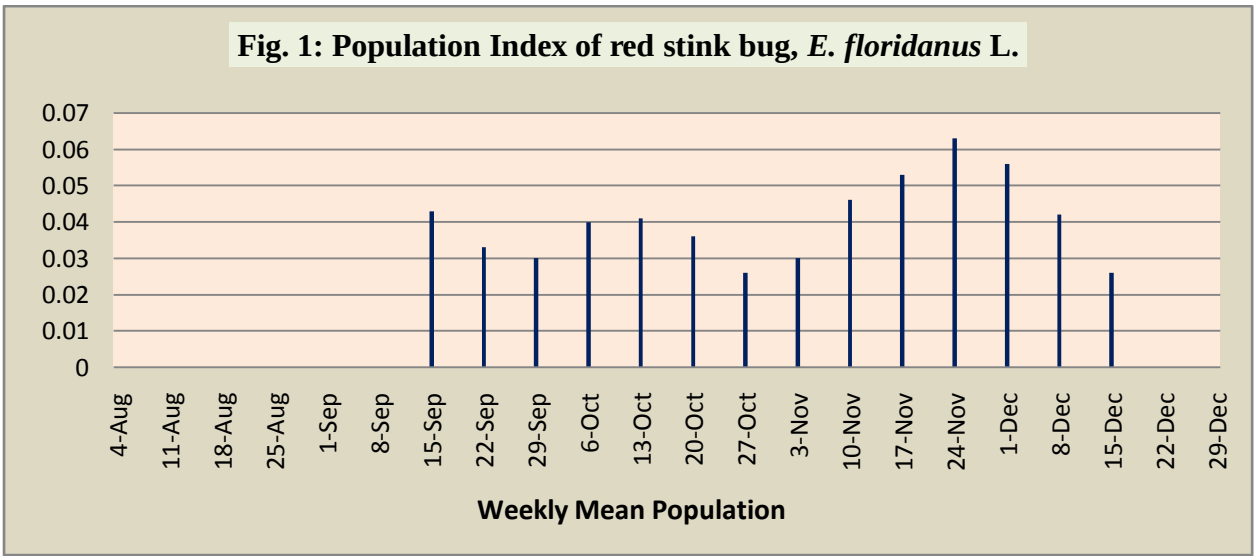
d) 3rd instar nymph

After 3-4 days

c) 2nd instar nymph

Population index

The Florida predatory red stink bug was recorded as the major predatory bug of *Udaspes folus.* Maximum population of red stink bug. *E. floridanus* was observed during the month of November last week, which was recorded to be 0.063 bug per plant and minimum population recorded to be 0.026 bug per plant during the month of December second week. (Fig.1)



The correlation analysis of population of red stink bug with weather parameters showed that highly significantly positively correlated with maximum temperature (0.130**) and highly significant negatively correlated with minimum temperature (-0.269**), rainfall(-0.573**), relative humidity-I (-0.579**) & II (-0.460**).

Correlation of predatory red stink bug, *E. floridanus* with its host larvae *Udaspes folus* depicted a highly significant positive correlation (0.208**).

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STUDY OF OPINIONS AND CHARACTERISTICS OF THE MEMBERS AND NON MEMBERS OF THE PANCHAYATS, IN BAGHPAT DISTRICT

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Abstract: No doubt India lives in the villages and about 50 per cent of the 6.41 lac villages of the country are situated in different terrain characterized by poor socio-economic condition. Even a casual glimpse at the sub continent of India is sufficient to convince that ours is a land of villages. Good majorities of her people i.e. nearly 68.84 per cent lives in villages and are occupied in the agriculture. According to the latest census figures, there are only 7936 towns in India; whereas the numbers of villages are 6.41 Lac. The 'Rig-Veda' which is considered as the oldest book in Indian culture too, has not been devoid of mention of villages. The literature succeeding the Rig-Veda. -The Ramayana and the Gita- in the epic period, Buddha period, Maurya period, and Gupta period etc. are profuse in their description of village. Although the Panchayats have historically been an integral part of rural life in India, these Acts have institutionalized the Panchayati Raj Institutions (PRIs) at the village, Block, and district levels as the third tier of government. The aim has been to combine social justice with effective local governance, with an emphasis on reservation of seats for the deprived classes of population, including of the leadership positions. with political empowerment having been established through a system of regular election to the three tiers of the Panchayats in all the States except Jharkhand, the task at hand has been to accelerate, widen, and deepen the process of empowerment so that these institutions of self government become the 'principal authorities' for planning and implementation.

Keyword: Panchayat, Opinion, Characteristics, Members, Villages

INTRODUCTION

India has always attracted attention of the world as being one of the oldest civilizations with kaleidoscopic variety and rich cultural heritage.

There are about 3 million elected representatives at all levels of the panchayat, one third of which are women. These members represent more than 2.4 Lac gram panchayats and more than 500 district panchayats spread over the length and breadth of the country, the new panchayats cover about 96 per cent of India's more than 6.41 Lac villages and nearly 99.6 per cent of rural population. This is the largest experiment in decentralization of governance in the history of humanity.

Panchayati Raj

Panchayati Raj system is a three-tier stem in the state with elected bodies at the Village, Block, and district levels. It ensures greater participation of people and more effective implementation of rural development programmes. There will be a Gram Panchayat for a village or group of villages, Kshetra Panchayat at block level and the Zilla Panchayat at the district level. The Ministry of Rural Development is engaged in bringing about rapid and sustainable development and socio-economic transformation in rural India. During the last few years foremost priority has been accorded to development in rural areas. A number of initiatives have been taken by this Ministry in the form of launching of new programmes, and restructuring of earlier programme to make them more effective and promotion of participation of people in the development process.

According to the census 2011, the total population of India is 121,01,93,42 crore, as was recorded 102,70,15,247 crore, in the census 2001. Compared to census 2011, it shows an increase of 18.1crore. According to the census 2011 the total literacy is 74.04 as compared to 64.8 per cent literacy in the census 2001.

The working population of India in 2011 stood at 46.02 crore, 38.02 per cent of the total population. The total number of main workers was 33.45% and that of the marginal workers were 3.32%. Out of the total main workers, 13.91 per cent were cultivators, 8.34 per cent agricultural labourer, 1.16 per cent household industrial workers and 10.04 per cent were other workers. Even a casual glimpse at the sub continent of India is sufficient to convince that ours is a land of villages. Good majorities of her people i.e. nearly 68.84 per cent lives in villages and are occupied in the agriculture. According to the latest census figures, there are only 7936 towns in India; whereas the numbers of villages are 6.41 Lac. The villages thus possess prominent position in the Indian society, since the earliest times the village has been the pivot of administration in India and it is still the keystone of national economy. Hence it is an established fact that without the prosperity of "Rural people" India cannot progress. The 'Rigveda' which is considered as the oldest book in Indian culture too, has not been devoid of mention of villages. The literature succeeding the Rigveda - The Ramayana and the Gita- in the epic period, Buddha period, Maurya period, and Gupta period etc. are profuse in their description of village.

Since the time immemorial the village was a self sufficient republic which functioned through the

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institution of Panchayat. There is clear and confirmed evidence of the survival of this village institution in some forms in almost every part of India until lately. No more distinctive tribute has perhaps been paid to these surviving panchayats by the then Britishers themselves who struck almost a fatal below to them by their policy of comprehensive centralization and by their calculated interference in day today life of the Indians due to which the self sufficient nature of the old democratic rural polity was broken. The village Panchayat as useful rural institution has ranked into insignificance. The position of the villages in every respect has deteriorated.

On the basis of about problems the following objective was set up for the study of village panchayat for rural development.

To study the opinions and characteristics of the members and non members of the Panchayats.

RESEARCH METHODOLOGY

Research methodology is of paramount importance in any scientific study as the validity and reliability of the facts depend upon the system of investigation. It provides the details of the various aspects concerning the research methodology. The scientific steps required to carry out the research are being discussed below in depth.

A. Selection of the state

In 1947, when India gained independence, the state of United Provinces was renamed as Uttar Pradesh. Uttar Pradesh is the biggest of 31 States in India. Uttar Pradesh is now divided into seventy five districts under eighteen divisions There are 80 Lok Sabha constituencies and 403 Vidhan Sabha seats, Uttar Pradesh is surrounded by Nepal and the Indian states of Bihar, Jharkhand, Chhattisgarh, Madhya Pradesh, Rajasthan, Haryana, Uttarakhand and National Capital Territory of Delhi. The Himalayas lies in the north of the state and the Deccan Plateau is at the south. In between them, the river Ganges, Yamuna, Ghaghara flow eastwards.

B. Selection of the district

There are 75 districts in the state of U.P. The Research was conducted in the District of Baghpat (U.P.). The District of Baghpat was purposively selected by the researcher as he has six year professional carrier as a lecturer in one of the colleges of the district. This helps him to have better insight into the social, economic, political and technological conditions of the locale.

C. Selection of the block

The list of development block was collected from the office of the district headquarter of Baghpat. Baghpat District has the privilege of having six blocks namely Baghpat, Baraut, Binauli, Chaprauli, Khekra and Pilana. Out of six blocks, Baghpat and Baraut blocks were selected purposively keeping in view of the nature of study.

D. Selection of the village panchayat

Firstly, the list of village panchayat was collected from the Block office of the Baraut and of Baghpat. Then from this list, 10 village panchayats were selected comprising five village panchayats from each block.

E. Selection of the respondents

A complete list of the members of gram sabha and members of village panchayat was prepared. Out of the list 10 members of village panchayat and 20 members of gram sabha were finally selected using stratified random sampling method. Thus it was total of 300 respondents to be interviewed i.e.100 members of village panchayat and 200 members of gram sabha.

RESULT AND DISCUSSION

The finding of the research of investigation is presented in following table.

Table 1. Opinion of respondents about working of village panchayat.

S.No.	Work	Opinion	Respondents		Total	X^2
			Gram sabha No/%	Village panchayat No/%		
1	Help in the construction work for rural development like roads, panchayat Ghar, Toilets etc	A.	174 (87.00)	96 (96.00)	270 (90.00)	X^2=7.22, 2D.F. Not significant
		N.	9 (4.50)	3 (3.00)	12 (4.00)	
		D.	17 (8.50)	1 (1.00)	18 (6.00)	
2	Help in the implementing government plan of health and sanitation	A.	129 (64.50)	62 (62.00)	191 (63.67)	X^2=4.52, 2D.F. Significant, at 5% level
		N.	54 (27.00)	35 (35.00)	89 (29.67)	

		D.	17 (8.50)	3 (3.00)	20 (6.66)	
3	Help in the dig ponds fill water in them and start fisheries cultivation	A.	128 (64.00)	44 (44.00)	172 (57.33)	X^2=13.191, 2D.F. significant
		N.	44 (22.00)	41 (41.00)	85 (28.33)	
		D.	28 (14.00)	15 (15.00)	43 (14.34)	
4	Help in the providing economic help for old, widows, poor and handicapped men and women	A.	154 (77.00)	87 (87.00)	241 (80.34)	X^2=4.29, 2D.F.significant. At 5% level
		N.	27 (13.50)	7 (7.00)	34 (11.33)	
		D	19 (9.50)	6 (6.00)	25 (8.25)	
5	Panchayat help in the implementation and awareness about agricultural development plans	A.	43 (21.50)	18 (18.00)	61 (20.33)	X^2=0.551 2D.F. not significant
		N.	107 (53.50)	57 (57.00)	164 (54.67)	
		D.	50 (25.00)	25 (25.00)	75 (25.00)	
6	Panchayat help in providing improved variety of seeds, machineries, chemical fertilizer and pesticide from government store	A.	30 (15.00)	18 (18.00)	48 (16.00)	X^2=2.94, 2 D.F. Not significant
		N.	103 51.50)	41 (41.00)	144 (48.00)	
		D.	67 (33.50)	41 (41.00)	108 (36.00)	
7	Panchayat help in the plantation on Gram Sabha Land	A.	108 (54.00)	64 (64.00)	172 (57.33)	X^2=3.221 2 D.F. Not significant
		N.	45 (22.50)	15 (15.00)	60 (20.00)	
		D.	47 (23.50)	21 (21.00)	68 (22.66)	
8	Panchayat help to arrange market for local agricultural products	A.	19 (9.50)	6 (6.00)	25 (8.33)	X^2 Value =1.068 2 D.F. Not significant
		N.	50 (25.00)	26 (26.00)	76 25.33)	
		D.	131 (65.50)	68 (68.00)	199 (66.33)	
9	Panchayat help in testing of soil fertility	A.	66 (33.00)	29 (29.00)	95 (31.66)	X^2 = 1.531 2 D.F. Not significant
		N.	81 (40.50)	48 (48.00)	129 (43.00)	
		D.	53 (26.50)	23 (23.00)	76 (25.33)	
10	Panchayat help in the providing drinking water facilities	A.	164 (82.00)	83 (83.00)	247 (82.33)	X^2 =3.150 D.F. Not significant
		N.	20 (12.00)	5 (5.00)	25 (8.33)	
		D.	16 (8.00)	12 (12.00)	28 (9.33)	
	Total		200 (100.00)	100 (100.00)	300 (100.00)	

Table 1. clearly reveals that very high majority i.e. 87.00 per cent, 82.00 per cent, 77.00 per cent, 64.50 per cent, 64.00 per cent, and 54.00 per cent respondents of gram sabha have shown positive opinion in terms of being agree against statement of help in the construction work for rural development

like roads, Panchayat Ghar, Toilets etc, Panchayat helps in the providing drinking water facilities, help in the providing economic help for old, widows, poor and handicapped men and women, help in the implementing government plan of health and sanitation, help in the dig ponds fill water in them and start fisheries cultivation and panchayat help in the plantation on Gram Sabha Land respectively in case of gram sabha. While very high majority i.e. 96.00 per cent, 87.00 per cent, 83.00 per cent, 64.00 per cent and 62.00 per cent respondents have shown positive opinion in term of agreeness in case of village panchayat against the statement of help in the construction work for rural development like roads, Panchayat Ghar, Toilets etc, help in providing economic help for old, widows, poor and handicapped men and women, Panchayat help in providing drinking water facilities, Panchayat help in the plantation on Gram Sabha Land and help in implementing government plan of health and Sanitation respectively. Table further reveals that overall majority i.e. 90.00 per cent, 82.33 per cent, 80.34 per cent, 63.67 per cent, 57.34 per cent and 57.33 per cent respondents have shown positive opinion in term of agreeness against statement, help in the construction work for rural development like roads, Panchayat Ghar, Toilets etc, Panchayat help in providing drinking water facilities, help in providing economic help for old, widows, poor and handicapped men and women, help in the implementing government plan of health and sanitation, panchayat help in the plantation on Gram Sabha Land and help in the dig ponds fill water in them and start fisheries cultivation respectively.

Table further reveals that majority 53.50 per cent, and 57.00 per cent in case of gram sabha and village panchayat have hold neutral opinion against statement of 'Panchayat help in the implementation and awareness about agricultural development plans'. Majority i.e. 68.00 per cent in case of gram panchayat and 65.50 per cent respondents in case of gram sabha respondents have shown disagreenesss against 'Panchayat help in the arrangement of market for local agriculture product.

Thus from the above explanation, it may be concluded that majority of respondents of gram sabha and gram panchayat had shown positive opinion in term of agreeness regarding overall working pattern of village panchayat.

CONCLUSION

The overall that majority i.e. 51.00 per cent and 51.00 per cent respondents have shown positive opinion in term of agreeness in case of gram sabha and village panchayat and minimum i.e. 22.00 per cent and 21.00 per cent respondents have shown disagreeness in case of gram sabha and village panchayats about working pattern under their jurisdiction. Further reveals that majority i.e. 51.00 per cent respondents have shown positive opinions in term of agreeness regarding working of both institutions, while the maximum i.e. 21.70 per cent respondents have shown negative opinion in terms disagreenes.

Thus from the above discussion, it may be concluded that majority of the respondents have shown their opinion in term of agreeness regarding working profile of village panchayat. The x^2 value observed was 0.055 which is not significant result indicates no difference in working profile of village panchayat and gram sabha members.

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EFFECT OF DIFFERENT DOSES OF NPK ON TARGETED YIELD AND QUALITY OF SOYBEAN

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Abstract: A field experiment was conducted during kharif season on fine montmorillonitic, Hyperthermic, family of Typic Haplustert soil at research farm of the Soil Science Department, JNKVV, Jabalpur. In order to study the effects of different doses of NPK on targeted yield and quality of soybean, based on targeted yield was laidout in randomized block design with five treatments consisted of T_1= control, T_2= GRD (20.60.20), T_3= Targeted Yield (25 qha^{-1}), T_4= Targeted Yield (30 qha^{-1}) and T_5= Targeted Yield (35 qha^{-1}). The soil of experimental field was normal in soil reaction (pH 7.72), EC (0.305 dSm^{-1}) and 0.49 % OC with low in available N, medium in P, K, and S having 124, 12, 370 and 11.45 kgha^{-1} respectively. The results indicated that different doses of fertilizers based on targeted yield affected the yield of soybean significantly over control and general recommended doses (GRD) of fertilizer for various set targeted yield. The highest yield of seed and Stover were recorded in treatment T_5 having 31.35 and 61.48 q ha^{-1} respectively. Also, the highest nutrient content of NPK were 2.78, 0.17 and 0.78 percent at 30 DAS respectively. The analyzed quality of soybean such as oil and protein content was highest in T_4 i.e. 19.45 and 42.93 per cent, respectively. It was reckoned that for set of target yield based on soil test value, use of NPK fertilizers can be best practice for nutrient buildup and assimilation of higher seed protein and oil content. The targeted yield was increased by 32.25 percent over control. The available nitrogen, phosphorous and potash were found to increase with respect to initial status.

Keywords: Fertilizer, Soybean, Seed yield, Oil, Protein content

INTRODUCTION

Soil is an important medium for plant growth supplying nutrients and moisture to crops in addition to providing mechanical anchorage. The importance of fertilizer nutrients are well recognized for enhancing crop yields. Balanced nutrition considers having all the essential nutrients available to the plant in adequate amounts. Although, the entire range of essential nutrients is involved in balanced nutrition generally the emphasis is being made on proper balance among N, P and K. The use of chemical fertilizer may be helpful in increasing crop productivity and soil health. It is essential that the nutrient demand of a crop to produce a target yield and the amount removed from soil may be replaced sooner or later. Nutritional management is one of the important constraints identified for restricting soybean yield (Bhist and Chandel 1996) and its sustainability (Abrol and Palaniappan 1998) through nutritional management has been reported apart limitations offered by major nutrients, correction of deficiency of sulphur (S) and (Zn) in soils of Madhya Pradesh is of equal importance (Tondon 1991).Targeted yield based on soil test is now being adopted by the farming community as this practices leads to balanced use of fertilizer for better crop yield and sustainable soil health.

METHOD AND MATERIAL

The present investigation entitled "Effect of different doses of NPK on targeted yield and quality of Soybean [Glycine max (L) Merill]". was carried out during (Kharif) season of 2011 at the Research Farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya , Jabalpur (India). With five treatments consisting of T_1: control ; T_2: GRD (20:60:20 NPK kg ha^{-1}); T_3: (51:73:10 NPK kg ha^{-1}); T_4: (77:99:20 NPK kg ha^{-1}); and T_5: (103:125:40 NPK kg ha^{-1}).The soil of experimental field was clayey with average values of soil pH (7.72), EC 0.305 d Sm^{-1}), OC (4.90 g kg^{-1}), available N (124.44 kg ha^{-1}), P (12.00 kg ha^{-1}) and K (370.30 kg ha^{-1}), respectively. At harvest, soil and plant samples were collected, air dried then plant samples was oven dried and then both samples were processed. The chemical analysis of the plant sample was carried out by wet digesting with HNO_3:$HClO_4$ (4:1) di-acid mixture as per the procedure outlined by (Jackson, 1973) and to determine concentrations of N, P and K at harvest using procedure described by (Jackson, 1973). The seed and stover yield of soybean were collected of each plot after harvesting. The soil samples were analyzed for pH using 1:2.5 soil: water suspension, electrical conductivity by conductivity meter (Jackson, 1973), organic carbon by rapid titration method (Walkley and Black, 1934). Available N estimated by alkaline permanganate method (Subbiah and Asija, 1956), available P by Olsen's method (Olsen *et al.* 1954), available K by ammonium acetate extraction method (Jackson, 1967). The analysis of variance was carried out using the randomized block design (Gomez and Gomaz, 1984).

Fertilizer adjustment equation (FAEs)

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Soybean

FN = 5.19 T - 0.48 SN

FP_2O_5 = 5.20 T - 4.10 SP

FK_2O = 3.90 T - 0.22 SK

RESULT AND DISCUSSION

Seed and stover yields

The data on seed and Stover yields of soybean are presented in Table 1 indicated that seed and Stover yields of soybean under various treatments were found significantly higher over control. Higher targeted yield of 35 q ha^{-1} by T_5 could not be achieved and deviated by ±10.43 % negatively, whereas, the target of 25 q ha^{-1} was obtained comfortably. The treatment T_5 target could not be achieved. However; it resulted significantly superior over rest of the treatments. The yield increased over control by 32.25 percent and over GRD by 15.79 percent, respectively. The effect of treatments on Stover yield also followed the similar trend as that of seed yield. It was attributed in the target yield with balanced fertilization augmented high yield. These result confirms with the results reported by Mishra and Vyas (1992); Warade *et.al.* (1992); Bhosle *et al.*, (1995) and Pandya *et al.* (2005). The overall increase in yield due to treatments either GRD or soil test based fertilizer alone have markedly augmented yield of soybean attributed to optimum available of nutrient for plant growth.

Table 1. Effects of different treatments on seed and Stover yields of soybean.

Treatment	Soybean yield (q ha^{-1})	
	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})
T1: Control (No fertilizer)	21.24	37.64
T2: GRD(20-60-20 NPK Kgha-1)	26.40	48.39
T3: TY 25qha-1 (51-73-10 NPK Kgha-1)	27.90	52.23
T4:TY 30qha-1 (77-99-20NPK, Kgha-1)	29.75	57.21
T5:TY35qha-1 (103-125-40 NPK Kgha-1)	31.35	61.48
S Em ±	**1.05**	**2.14**
CD *(p = 0.05)*	**3.22**	**6.58**

Effect of treatments on primary available nutrients (N, P and K) in soil.

Data on primary available nutrients as affected by different treatment at different stages are presented in Table 2. The data indicated that various treatments varied significantly with nutrient content. The nitrogen content increased with increasing levels of N at 30 DAS and gained at 45 DAS being increased to 213 Kgha-1but decreased at higher dose of NPK with higher targeted, but at 60 DAS and at harvest it depleted.

The nitrogen content was recorded significantly superior over control having 263.42 and 250.88 $kgha^{-1}$ under treatment T_5 (T.Y. 35 q ha^{-1}) at 30 and 45 DAS whereas 188.16 and 175 $kgha^{-1}$ in T_2 at 60 DAS and at harvest was recorded. However, there was decrease in the content which may be attributed the demand of nitrogen was more for grain setting.

The phosphorous concentration also followed the similar trend as that of nitrogen. Comparatively P was higher at 30 DAS at higher dose and decreased with advancement in growth up to harvest. The variation in the P content differed significantly with respect to treatments but there was no much difference noticed with growth stages but was very meager decrease was recorded by 1Kg from 30 days to the harvest stage. The decrease was observed at higher doses of fertilizer up to 7 $Kgha^{-1}$ which can be attributed to the fact that P was mostly required for seed development.

Data on potassium content as affected by different treatments at different stages (30, 45, 60 DAS at harvest) are presented in Table 2.The data revealed that potassium content was comparatively higher having 435 $Kgha^{-1}$ with higher target T_5 at 30 DAS as compared to 45 and 60 DAS and harvest. The potassium content was recorded significantly superior as compared to control at all the growth stages. Similar results have been reported by Dubey and Shrivastava (1991). Tiwari *et al (*2002) Sharma and Vikas (2007). Similarly Singh at el. (2012) and Swarup and Rao (1999) also reported that the available N status could only be maintained through integration of fertilizer and manure for increasing the nutrients use efficiency of N over imbalance fertilizer use. On the other hand appreciable, build up was recorded when fertilizer addition raised from optimal to super optimal dose. Similarly, a considerable higher amount of available P was accumulated when NPK fertilizer was applied with FYM. The findings reported by Swarup and Yaduvanshi (2000) and Dwivedi et al. (2007) are also in agreement with the present investigation. These results are agreement with the findings of Bharadwaj et al.

(1984) and Mandal et al., (1991) who have also observed similar effects on available K status of soil arising out of application of either NP or N alone.

Table 2. Effect of treatments on the available nutrient content in soil

Treatments	Available Primary Nutrients (kg ha^{-1})											
	30 DAS			45 DAS			60 DAS			At harvest		
	N	P	K	N	P	K	N	P	K	N	P	K
T1:Control (No fertilizer)	137.98	10.75	370.45	213.25	9.88	358.32	188.16	9.15	351.87	175.62	8.15	337.48
T2:GRD(20-60-20 NPK Kgha-1)	175.62	12.27	383.15	238.34	10.7	374.1	213.25	10.1	364.73	188.16	8.65	345.52
T3: TY 25qha-1 (51-73-10 NPK Kgha-1)	200.7	12.68	398.2	225.79	11.21	381.96	200.7	10.55	350.41	175.62	7.8	320.27
T4:TY 30qha-1 (77-99-20NPK, Kgha-1)	238.34	13.36	421.53	238.34	11.78	398.4	188.16	10.9	331.67	150.53	7.1	301.78
T5:TY35qha-1 (103-125-40 NPK Kgha-1)	263.42	13.78	435.4	250.88	12.16	409.33	175.62	11.17	314.55	125.44	6.3	288.56
S Em ±	3.17	0.2	6.65	3.56	0.174	6.12	3.01	0.162	5.34	2.44	0.114	4.86
CD *(p = 0.05)*	9.75	0.616	20.49	10.97	0.535	18.84	9.27	0.498	16.45	7.5	0.35	14.98

Oil and protein content in seed

Data presented in Table 3 indicated that oil content of soybean was higher in T4 (T.Y. 30 qha$^{-1)}$ there after it declined at higher dose of inorganic fertilizers. Various treatments showed significant influence on oil content of soybean. Maximum oil content in seed (19.45 %) was obtained in treatment T_4, having targeted yield of 30 qha^{-1} which was significantly superior over rest of the treatments except T_5 (T.Y. 35 qha^{-1}) and T_3(T.Y. 25 qha^{-1}).

Data on protein content of grain as affected by different treatment are presented in Table 3.The protein content was comparatively higher in T_4 (T.Y. 30qha^{-1})as compared to rest of the treatments.The different treatment enhanced the protein content significantly. Data on protein content was obtained significantly superior (42.93%) in T_4 (T.Y. 30qha^{-1}) as compared to T_5 (T.Y. 35 q ha^{-1}), that was statistically at par with rest of the treatments. The protein content was observed to increased over T1 (control) by T5, having higher targeted yield of 35 qha^{-1} supplemented with higher dose of fertilizer. Oil and protein (19.45 and 42.93 %) was higher recorded under in T4 (T.Y. 30qha^{-1}). Protein and oil is the major constituent contributing to the quality of any crop. The supply of balance nutrient to the growing plant influenced the protein and oil metabolism .As the supply of nutrient decreases the reduction of the plant-synthesis exhibited under such condition. Protein and oil synthesis initially checked has been estimated by El-Essawai and Abadi (1990), who indicated that seed oil and protein yield of soybean increased with balance application of NPK.

Table 3. Effect of treatments on oil and protein content in soybean Seed

Treatment	Soybean oil and protein	
	Oil	Protein
T_1: Control (No fertilizer)	17.83	40.56
T_2: GRD (20-60-20 NPK Kgha-1)	18.10	41.18
T_3: TY 25qha^{-1} (51-73-10 NPK Kgha-1)	18.60	41.43
T_4:TY 30qha^{-1} (77-99-20NPK, Kgha-1)	19.45	42.93
T_5:TY35qha^{-1} (103-125-40 NPK Kgha-1)	18.78	41.68
S Em ±	**0.289**	**0.632**
CD *(p = 0.05)*	**0.890**	**1.95**

Table 4. Manurial scheduling for Soybean

Treatments	Nutrient applied (kg ha^{-1})		
	N	P_2O_5	K_2O
Control	0	0	0
GRD	20	60	20
T.Y. 25 q ha^{-1}	51	73	10
T.Y. 30 q ha^{-1}	77	99	20
T.Y. 35q ha^{-1}	103	125	40

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BIO-EFFICACY OF INSECTICIDE FORMULATIONS AGAINST TWO LEPIDOPTEROUS INSECTS OF RICE

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Abstract: Extent of suppression of yellow stem borer *Scirpophaga incertulas* and leaf folder *Cnaphalocrocis medinalis* infestation on rice crop by six insecticides formulations was studied in the field conditions of rice variety swarna during two consecutive Kharif seasons of 2013 and 2014. Experiment was done following complete randomized block design and had three replications for each year. All treatments were significantly effective in checking stem borer infestation causing the decrease of both percent dead heart and folded leaves Numerically least damage was recorded for profenophos + cypermethrin 44% @ 1000 ml/ha. during first and second spray for both 7 and 15 days after spraying as 3.83,4.50,7.16 and 7.84 percentage of dead heart/10 hills,respectively.In case of leaf folder during first and second spray for both 7 and 15 days after spraying the percentage folded leaves/10 hills noticed as 0.65,1.08,1.86 and 2.35 respectively with maximum yield of 49.64 q/ha.

Keywords: *Scirpophaga incertulas,Cnaphalocrocis medinalis* , Insecticide formulations

INTRODUCTION

Rice is the most important food crop that has been improved since its domestication about 8000 years ago. It is the staple food of half of the world's population. India leads the world in rice area with 41.85 m ha with a production of 102 m tonnes, but productivity is only 75 % of the world average of 4.02 tonnes ha (Anonymous, 2012).Though insect pests have been regarded as an important constrain in paddy cultivation through the centuries, occurrence of pest outbreaks have increased with the change of pest complexities, in the last four decades (Ahmed et al., 2010). Paddy leaf folder is one of the most important insect pests in Indian subcontinent (Gunathilangaraj et al., 1986). Out of the eight species of leaf folder, the most widespread and important one is *Cnaphalocrocis medinalis* (Guenee) (Bhatti et al., 1995). Feeding of *Cnaphalocrocis medinalis* often results in stunting, curling or yellowing of plant green foliage (Alvi et al., 2003)

The yellow stem borer *Scirpophaga incertulas* is the worst pest which can cause severe damage and yield loss to the rice crop in the later stage. In India, the losses incurred by different insect pests are reported to the tune of 55.12 million rupees which in turn workout to 18.16 per cent of total losses. Out of this, 20 to 30 per cent damage is alone done by yellow stem borer, *Scirpophaga incertulas* (Walker) (Lal, 1996). The yellow stem borer *Scirpophaga incertulas* (Walker) has assumed the number one pest status and attacks the rice crop at all stages of its growth (Pasulu et al., 2002.). It causes dead hearts at active tillering stage and can lead to complete failure of the crop (Karthikeyan and Purushothaman, 2000). Among the various strategies adopted to combat the pest of rice, insecticides are the first line of defense.

MATERIAL AND METHOD

A field experiment was conducted during Kharif 2013 and 2014. The experiment was laid out in a randomized block design with nine treatments and three replications. The variety swarna was sown during the month of July in respective seasons. Seedlings were transplanted 30 days after sowing with spacing of 20 x 15 cm. All the agronomic practices were followed as per the recommended package of practices. The knapsack sprayer and spray volume @ 500 l/ha was used with hollow cone nozzle to impose the spray treatments. Following treatments were imposed twice in a season, one at vegetative and second one at reproductive phase of the crop. The Per cent dead heart and Per cent folded leaves were recorded by following standard method for stem borer and leaf folder (Anon., 2007)

Per cent dead heart

$$= \frac{\text{Number of plants with dead heart}}{\text{Total number of plants}} \times 100$$

Per cent leaf damage

$$= \frac{\text{Number of damaged leaves}}{\text{Total number of leaves}} \times 100$$

The observations on stem borer and leaf folder were recorded on 10 hills selected randomly and averaged to per hill basis. Observation of freshly damaged or folded leaves/hill just before spray and at interval 7 and 15 days after spray for leaf folder, whereas percentage dead heart/hill just before spray and at interval 7 and 15 days after spray for stem borer. Yield data was recorded in quintals/ha.

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The detail of insecticidal treatments is given as under;

S.No.	Treatment	Dose /ha (g or ml)
1.	Profenophos + cypermethrin 44 EC	500
2.	Profenophos + cypermethrin 44 EC	750
3.	Profenophos + cypermethrin 44 EC	1000
5.	Profenofos 50 EC	1000
6.	Cypermethrin 10EC	500
7.	Acephate 75 SP	1000
8.	Lambda Cyhalothrin 5 EC	250
9.	Control	-

RESULT AND DISCUSSION

All insecticidal treatments were found effective over control for leaf folder (*Cnaphalocrosis medinalis*). In 2013-14, among all Profenophos + cypermethrin 44% @ 1000 ml/ ha was found most effective during 1st& 2nd sprays for both 7 & 15 days after spraying as 0.65, 1.08, 1.86 and 2.35 percentage of folded leaves/ 10 hills, respectively. Which was at par with Profenophos + cypermethrin 44% @ 750 ml/ ha as 0.70, 1.24, 2.09 and 2.64 percentage of folded leaves/ 10 hills, respectively. Similarly, in 2014-15, among all Profenophos + cypermethrin 44% @ 1000 ml/ ha was found most effective during 1st& 2nd sprays for both 7 & 15 days after spraying as 1.44, 1.68, 2.78 and 2.98 percentage of folded leaves/ 10 hills, respectively. Which was at par with Profenophos + cypermethrin 44% @ 750 ml/ ha as 1.52, 1.81, 2.94 and 3.10percentage of folded leaves/ 10 hills, respectively.

All the insecticidal treatments were found effective over control for stem borer (*Scirpophaga incertulas*).In 2013-14, among all Profenophos + cypermethrin 44% @ 1000 ml/ ha was found most effective during 1st& 2nd sprays for both 7 & 15 days after spraying as 3.83, 4.50, 7.16 and 7.84 percentage of dead heart/10 hills, respectively. Which was at par with Profenophos + cypermethrin 44% @ 750 ml/ ha as 4.02, 4.79, 7.37 and 8.13percentage of dead heart/ 10 hills. Similarly, in 2014-15,among all Profenophos + cypermethrin 44% @ 1000 ml/ ha was found most effective during 1st& 2nd sprays for both 7 & 15 days after spraying as 6.34, 6.78, 8.44 and 8.60 percentage of dead heart/ 10 hills, respectively. Which was at par with Profenophos + cypermethrin 44% @ 750 ml/ ha as 6.51, 6.88, 8.60 and 8.71percentage of dead heart/ 10 hills, respectively.

The data present in table 5 reflect that the rice yield was also significantly influenced by insecticidal treatments. In 2013-14, among all treatment , maximum yield was found in Profenophos + cypermethrin 44% @ 1000 ml/ ha treated plot as 49.64 q/ha, which at par with Profenophos + cypermethrin 44% @ 750 ml/ ha as 45.12 q/ha. Similarly, in 2014-15,among all treatment , maximum yield was found in Profenophos + cypermethrin 44% @ 1000 ml/ ha treated plot as 51.74 q/ha, which at par with Profenophos + cypermethrin 44% @ 750 ml/ ha as 48.61 q/ha.

No specific observation on the impact of insecticide formulations on incidence in relation to local paddy cultivars was carried out earlier in the Raipur,Chhatisgarh.Saroja and Raju (1982) have viewed that cypermethrin and fanvalerate are best suitable pesticide to suppress leaf folder population and accordingly to maximize paddy yield. Bhanu et al. (2008) have noted considerable variations of the efficacy on pesticides in field condition. Wakil et al. (2001) from Pakistan have reported that not all the pesticides were equally effective to check leaf folder attack. Mishra *et al.* (1998) and Kushwaha (1995) who have noted that the population suppression capacity of monocrotophos and cypermethrin was essentially prudent in some regions of India.

CONCLUSION

On the basis of above results, Profenophos + cypermethrin 44% @ 1000 ml dose/ha (formulation) was found to be the effective in controlling stem borer (*Scirpophagaincertulas*) and leaf folder (*Cnaphalocrosismedinalis*).

Table 1. Effect of insecticides on rice leaf-folder during kharif 2013-14.

S. No.	Treatment	Dose /ha (g or ml)	Percentage of folded leaves / 10 hills						Average percentage of folded leaves/ 10 hill after spray
			Pre treatment	1st Spray		Pre treatment	2nd Spray		
				7 DAS	15DAS		7 DAS	15DAS	
1.	Profenophos + cypermethrin 44 EC	500	0.72 (3.91)	1.33 (6.53)	2.38 (8.87)	2.00 (8.05)	2.47 (9.03)	3.36 (10.54)	2.39
2.	Profenophos + cypermethrin 44 EC	750	0.53 (3.90)	0.70 (4.78)	1.24 (6.39)	1.66 (7.37)	2.09 (8.31)	2.64 (9.31)	1.67
3.	Profenophos + cypermethrin 44 EC	1000	0.63 (4.56)	0.65 (4.62)	1.08 (5.89)	2.01 (8.00)	1.86 (7.82)	2.35 (8.79)	1.40

4.	Profenofos 50 EC	1000	0.55 (3.43)	1.20 (6.27)	1.82 (7.74)	2.00 (8.05)	2.79 (9.59)	3.72 (11.11)	2.38
5.	Cypermethrin10EC	500	0.86 (4.33)	1.03 (5.78)	2.13 (8.39)	1.67 (7.29)	2.81 (9.62)	3.47 (10.73)	2.36
6.	Acephate 75 SP	1000	0.85 (4.30)	1.36 (6.66)	2.47 (9.03)	2.00 (8.05)	2.92 (9.84)	3.14 (10.17)	2.47
7.	Lambda Cyhalothrin 5 EC	250	0.81 (4.21)	0.98 (5.63)	1.49 (7.00)	2.03 (8.18)	2.38 (8.87)	2.97 (9.95)	1.96
8.	Control	-	0.72 (3.96)	1.79 (7.68)	2.82 (9.66)	2.05 (8.14)	3.54 (10.81)	4.36 (12.03)	3.13
CD 5%			**NS**	**0.80**	**1.10**	**NS**	**0.97**	**1.12**	

Figures in Parenthesis are Angular Transformed Values

Table 2. Effect of insecticides on rice leaf-folder during kharif 2014-15.

S. No.	Treatment	Dose/ha (g or ml)	Percentage of folded leaves / 10 hills						Average percentage of folded leaves/10 hill after spray
			Pre treatment	1st Spray		Pre treatment	2nd Spray		
				7DAS	15DAS		7DAS	15 DAS	
1.	Profenophos + cypermethrin 44 EC	500	1.44 (6.88)	1.96 (8.04)	2.50 (9.09)	2.94 (9.86)	3.44 (10.64)	3.72 (11.15)	2.91
2.	Profenophos + cypermethrin 44 EC	750	1.36 (6.69)	1.52 (7.07)	1.81 (7.72)	2.74 (9.52)	2.94 (9.86)	3.10 (10.16)	2.34
3.	Profenophos + cypermethrin 44 EC	1000	1.40 (6.79)	1.44 (6.88)	1.68 (7.44)	2.64 (9.34)	2.78 (9.59)	2.98 (9.93)	2.22
4.	Profenofos 50 EC	1000	1.11 (6.04)	1.86 (7.84)	2.36 (8.83)	2.84 (9.69)	3.33 (10.50)	3.58 (10.90)	2.78
5.	Cypermethrin 10EC	500	1.31 (6.56)	1.91 (7.93)	2.44 (8.98)	2.91 (9.81)	3.41 (10.63)	3.64 (10.99)	2.85
6.	Acephate 75 SP	1000	1.26 (6.43)	2.03 (8.18)	2.66 (9.38)	2.68 (9.41)	3.56 (10.87)	3.72 (11.11)	2.99
7.	LambdaCyhalothrin 5 EC	250	1.31 (6.56)	1.72 (7.53)	1.96 (8.04)	2.88 (9.76)	3.16 (10.23)	3.24 (10.36)	2.52
8.	Control	-	1.18 (6.23)	3.11 (10.12)	3.48 (10.74)	3.18 (10.27)	3.96 (11.47)	6.14 (14.34)	4.17
CD 5%			**NS**	**0.43**	**0.51**	**NS**	**0.47**	**0.32**	

Figures in Parenthesis are Angular Transformed Values

Table 3. Effect of insecticides on rice stem borer during kharif 2013-14.

S. No.	Treatment	Dose /ha (g or ml)	Percentage of dead heart / 10 hills						Average percentage of dead heart/10 hill after spray
			Pre treatment	1st Spray		Pre treatment	2nd Spray		
				7 DAS	15DAS		7 DAS	15 DAS	
1.	Profenophos + cypermethrin 44 EC	500	4.11 (11.68)	4.68 (12.48)	5.49 (13.54)	8.06 (16.47)	8.40 (16.83)	9.25 (17.69)	6.95
2.	Profenophos + cypermethrin 44 EC	750	3.83 (11.27)	4.02 (11.55)	4.79 (12.62)	7.95 (16.35)	7.37 (15.73)	8.13 (16.56)	6.08
3.	Profenophos + cypermethrin 44 EC	1000	4.15 (11.72)	3.83 (11.26)	4.50 (12.23)	7.73 (16.13)	7.16 (15.50)	7.84 (16.24)	5.83
4.	Profenofos 50 EC	1000	4.18 (11.74)	4.48 (12.20)	5.46 (13.50)	8.28 (16.71)	8.14 (16.56)	8.81 (17.24)	6.72
5.	Cypermethrin 10EC	500	3.59 (10.89)	4.59 (12.36)	5.71 (13.81)	8.46 (16.90)	8.36 (16.79)	9.03 (17.46)	6.92
6.	Acephate 75 SP	1000	3.45 (10.69)	4.89 (12.76)	6.19 (14.39)	8.22 (16.64)	9.49 (17.93)	11.15 (19.50)	7.93
7.	Lambda Cyhalothrin 5 EC	250	4.00 (11.52)	4.36 (12.14)	4.97 (12.83)	8.12 (16.54)	7.96 (16.37)	8.81 (17.24)	6.52
8.	Control	-	3.78 (11.18)	6.29 (14.51)	8.36 (16.79)	8.85 (17.29)	13.12 (21.22)	17.12 (24.42)	11.22
CD 5%			**NS**	**0.84**	**1.13**	**NS**	**0.83**	**0.94**	

Figures in Parenthesis are Angular Transformed Values

Table 4. Effect of insecticides on rice stem borer during kharif 2014-15.

S. No.	Treatment	Dose /ha (g or ml)	Percentage of dead heart / 10 hills						Average percentage of dead heart/10 hill after spray
			Pre treatment	1st Spray		Pre treatment	2nd Spray		
					15 DAS		7 DAS	15 DAS	
1.	Profenophos + cypermethrin 44 EC	500	5.88 (14.02)	7.33 (15.70)	7.84 (16.25)	8.38 (16.82)	9.34 (17.78)	9.44 (17.88)	8.49
2.	Profenophos + cypermethrin 44 EC	750	6.18 (14.38)	6.51 (14.77)	6.88 (15.20)	8.47 (16.91)	8.60 (17.04)	8.71 (17.49)	7.68
3.	Profenophos + cypermethrin 44 EC	1000	6.24 (14.46)	6.34 (14.57)	6.78 (15.08)	8.34 (16.77)	8.44 (16.88)	8.60 (17.04)	7.54
4.	Profenofos 50 EC	1000	5.71 (13.81)	7.14 (15.49)	7.36 (15.73)	8.88 (17.33)	9.14 (17.59)	9.26 (17.70)	8.23
5.	Cypermethrin 10EC	500	5.94 (14.10)	7.24 (15.52)	7.44 (15.82)	8.67 (17.11)	9.26 (17.70)	9.38 (17.82)	8.33
6.	Acephate 75 SP	1000	6.10 (14.29)	7.38 (15.75)	7.54 (15.93)	8.79 (17.23)	9.34 (17.78)	9.50 (17.94)	8.44
7.	LambdaCyhalothrin 5 EC	250	5.78 (13.90)	6.94 (15.26)	7.21 (15.56)	8.68 (17.12)	8.94 (17.39)	9.18 (17.63)	8.07
8.	Control	-	5.68 (13.78)	8.94 (17.39)	9.25 (17.69)	9.34 (17.78)	14.74 (22.56)	18.84 (25.71)	12.94
CD 5%			**NS**	**0.46**	**0.38**	**NS**	**0.42**	**0.56**	

Table 5. Effect of insecticides on yield during kharif 2013-14 and 2014-15.

S. No.	Treatment	Dose /ha (g or ml)	Yield q/ha (2013-14)	Yield q/ha (2014-15)
1.	Profenophos + cypermethrin 44 EC	500	37.43	36.87
2.	Profenophos + cypermethrin 44 EC	750	45.12	48.61
3.	Profenophos + cypermethrin 44 EC	1000	49.64	51.74
4.	Profenofos 50 EC	1000	39.33	40.45
5.	Cypermethrin 10EC	500	36.56	38.67
6.	Acephate 75 SP	1000	33.45	34.88
7.	LambdaCyhalothrin 5 EC	250	41.11	43.33
8.	Control	-	24.65	25.12
CD 5%			**7.98**	**7.46**

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SAFETY OF CERTAIN NEW INSECTICIDES TO MIRIDBUG POPULATION IN RICE ECOSYSTEM

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Abstract: Field experiment was conducted at Research and Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G) during kharif of 2006-07. The major predator is found to be associated in the rice ecosystem were mirid bug is an important predator of rice. Evaluation of newer insecticides in combination with present and new formulations of older molecules was thrust point of investigation. The application of alika 247 ZC @33 g.a.i./ ha. is safer for mirid bug. Application of Spinosad 45SC@56 g.a.i/ha., alika 247 ZC@44 g.a.i/ha. And monocrown 36 WSC @500 g.a.i/ha. Were found harmful to mirid bug.

Keywords: Insecticides, Population, Rice, Ecosystem

INTRODUCTION

Rice is the staple food of more than half of humanity in the world and for more than 65 to 70 % of Indian population. It is grown over 44 million hectare in India under diverse ecologies, like upland, lowland, Irrigated, deep water etc. Indian population is increasing @1.5% and it would need over 100 million tons of rice by 2015 and 120 million tons by 2020 (Anonymous, 2007a). This additional production has to come from declining and degrading resources like land and water. Chhattisgarh popularly known as "rice bowl of India" occupies an area around 3.60 m ha.with the production of 6.16 mt of paddy and was awarded Krishi Karman award during 2010-2011 (Anonymous, 2011).

An average productivity of 1323 Kg/ha, which is very low as compared to the national average of 2263 Kg/ha (Anonymous, 2007b). About 96 percent of total area under rice in the state is concentrated in low and very low productivity groups of the state (Sastri *et al*., 2006).

The major predator is found to be associated in the rice ecosystem were mirid bug is an important predator of rice. Development of integrated pest management (IPM) strategies is the most appropriate solution to tackle the pest problems. Target specific and eco-friendly insecticide application is one of the important components of IPM. Insecticide plays a major role in the production system of rice, in spite of their much highlighted hazardous effect on the environment. They are still relied upon by the rice farmers for better management of different pests. Continuous and consistent use of pesticides leads to the development of resistance among pests and adverse effects on non-target organisms.

To cope with ever challenging insects pest problems in Rice, the farmers needs to have the latest technological knowledge in pest management. Evaluation of new insecticides, combine them with present one and new formulations of older molecules is an important exercise of Rice entomologist.

MATERIAL AND METHOD

The present investigation entitled "Evaluation of effect of insecticidal spray on the mirid bug of rice plant'' was carried out at IGKV Research Farm, Raipur under field as well as glass house condition during Kharif season. The materials used and techniques adopted for this study is illustrated in this chapter.

Site and Climate

Raipur is an important rice growing tract of Chhattisgarh and comes under tropical region of India. It is situated at 21.16^0N latitude and 81.36^0E longitude and at an altitude of 299 meters above from mean sea level (MSL). The general climate condition of Raipur is sub-humid to semi-arid with annual rainfall of more than 1350 mm of which 85 percent occurring during June to September month.

Details of Experiment Conducted in Field Condition

Crop	**:** Rice
Situation	**:** Irrigated
Plot Size	**:** 5 x 4 m = 20m^2
Number of treatment	**:** 14
Number of replication	**:** 04
Total number of Plot	**:** 56
Plant spacing	**:** 20 x15Cm (R x P)

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No. of Hills per plot : 650 hills /plot
Date of treatment application : 15/09/2006 Ist spraying
06/10/2006 IInd spraying
Volume of spray solution used : @500 lit./ha
Type of spray applicator used : Manually-operated Knapsack sprayer

Table1. Treatment details

Treatment	Common name	Trade name	% a.i. in the Formulation	g a.i/ha Dose	g Or ml of formulation/ha
T1.	Chlorpyriphos	Dursban 10G	10%	1000	10.0 Kg
T2.	Chlorpyriphos	Dursban 10G	10%	1250	12.5 Kg
T3.	Carbofuran (check)	Furadan 3G	3.0%	1000	33.0 Kg
T4.	Ethiprole 40% + Imidacloprid 40%	Bayer	80%	100	125 g
T5.	Neonicotinoid + Synthetic pyrethroid	ALIKA 247ZC	22%	33	150 ml
T6.	Neonicotinoid + Synthetic pyrethroid	ALIKA 247ZC	22%	44	200 ml
T7.	Deltamethrin	Decis 10%EC	10%	15	150 ml
T8.	RIL 043 oxadiazin + synthetic pyrethoid)	-	-	-	400 ml
T9.	Indoxacarb	Kingdoxa 15 SC	14.5%	30	200 ml
T10.	Spinosyn A 50% + Spinosyn D 50%	Spinosad 45%SC	45%	45	100 g
T11.	Spinosyn A 50% + Spinosyn D 50%	Spinosad 45%SC	45%	56	120 g
T12.	Monocrotophos (check)	Monocrown 36 WSC	36%	500	1390 ml
T13.	Phorate 10G	Uthane (UPL)	10%	1000	12.5 Kg
T14.	Untreated control	-	-	-	-

Fertilizer application (N: P: K 80:60:40) Kg/ha
The paddy crop grown for experimental purpose was given nutrition through the chemical fertilizer @ 80:60:40 NPK kg/ha. Full dose of P and K were applied at the time of planting and "N" was applied in three split doses. First dose was given at the time of planting and remaining two doses were applied at the tillering and panicle initiation stage of the crop.

Method of insecticidal treatment application
The required quantity of insecticide for each plot was calculated on the basis of active ingredient and standard doses. Before applications of insecticide per plot insect population were counted for ten random plants in each plot, then the insecticidal treatments were applied to the crop homogeneously.

Time of insecticidal treatment application
All the insecticidal treatments were applied twice during the crop season. The first application was given as prophylactic treatment at 30 days after transplanting. The second insecticidal treatment application was given at the maximum tillering stage of the crop i.e.50 DAT. The increasing trend of insect infestation was observed at 50 DAT observations.

Sampling technique applied in field experimentation
The observations on occurrence of major insect pests of paddy were recorded in each plots after transplanting. The pre treatment and post treatment observations were recorded at 30 and 50 DAT on ten randomly selected hills from each plot.

Natural enemies: The populations of natural enemies present in the crop ecosystem were counted in each hill after insecticidal spraying for all the treatments. The major predators found to be associated in the paddy crop ecosystem were mirid bug. This information will be helpful in understanding the safety of insecticides for natural enemies of the insect pest.

Table 2. Population of Mirid Bug found to be associated under different insecticidal treatment during kharif - 2006

Treatment	Formulation g a.i/ha	Mean percentage of Mirid Bug on ten plant
T1 : Durban 10 G	1000	3.50 (1.99)
T2 : Durban 10 G	1250	2.50 (1.73)
T3 : Furadon 3 G	1000	3.50 (1.99)
T4 : Ethiprole 40% + Imidacloprid 40%	100	3.25 (1.92)
T5 : Alika 247 SC	33	3.75 (2.06)
T6 : Alika 247 SC	44	2.00 (1.58)
T7 : Decis 10 EC	15	2.75 (1.79)
T8 : RIL -043	400	2.25 (1.65)
T9 : Kingdoxa 14.5 SC	30	2.25 (1.65)
T10 : Spinosad-45 SC	45	3.50 (1.99)
T11 : Spinosad-45 SC	56	1.75 (1.48)
T12:Monocrown 36 WSC	500	2.00 (1.58)
T13 : Phorate 10 G	1000	3.50 (1.99)
T14 : Untreated control	-	4.75 (2.28)
SE (m) + CD(5%)		0.11 0.32

Figures in Parenthesis are square root transformed values.

RESULT AND DISCUSSION

This chapter deals with the brief description of results obtained under different objectives of this study. The findings of the present study are compared with the previous findings of the relevant aspects in justified manner to draw a concrete conclusion. The results and discussion are presented here under different sub headings:

Safety for natural enemies

Impact of insecticidal application were also accessed for the natural enemies of insects present in the crop ecosystem. This data will be helpful in deciding the safety of insecticidal treatment. The major predator found to be associated in the rice ecosystem were mirid bug. The post application observations of major predators were counted on ten random plant of each treatment replication.

Mirid bug

Minimum mirid bug population were recorded with Spinosad 45 SC @ 56 g a.i/ha (1.75) which was at par with Alika 247 SC @ 44 g a.i/ ha (2) and Monocrown 36 WSC @ 500 g a.i/ha (2) followed by Ethiprole + imidacloprid @ 100 g a.i/ha (3.25). The maximum mirid bug population 4.75 per ten plant was observed with the untreated control plot. The application of Alika 247 SC @ 33 g a.i/ ha was found statistically at par with the untreated control.

It may be stated that the application of Alika 247 SC @ 33 g a.i/ ha was found safer for mirid bug. The application of spinosad 45 SC, Alika 247 SC @ 44 g a.i/ ha and Monocrown 36 WSC @ 500 g a.i/ha were shown harmful effect to mirid bug. Panda *et.al.* (1991) reported synthetic pyrathroids as safer insecticide for mirid bug. Similar results were also reported by Sharma *et al.*2010.

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REPORTED

ALLIUM ROYLEI STEARN – A PROMISING MINOR CROP SPECIES.

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Abstracts: Recently Gopal (2014) in the meeting report on National Workshop on "Onion Improvement and Seed Production" laid emphasis on the prevention of onion shortage through genetic improvement. A number of bottlenecks brought to the fore included susceptibility to diseases, weather vagaries and non – availability of quality seeds. Among various remedial measures proposed to solve these problems; genetic improvement for better seed supply of onion was the most pronounced. Numerous gene transfer methods and breeding programmes were conducted and many are underway. The wild relatives of crop plants constitute important resource for improving agricultural production and also for maintaining sustainable agro-ecosystems. This, in trun, will ensure food security for the new millennium.

Keywords: Crop, Disease, Species, Onion

INTRODUCTION

Many wild species of *Allium* are repositories of numerous disease resistance and other desirable genes which can be exploited for the improvement of common onion (de Vries *et al*., 1992; Galvan *et al*., 1997). Onion, i.e., *A. cepa* is the most important crop grown in India for thousands of years. It is estimated to cover an area of 3,20,000 ha with a total production of 3.35 million tons working the average yield to 10.5t/ha (Pandita, 1994). On account of its being easily prone to numerous insects/ pests and fungal diseases especially downy mildew, late blight, anthracnose, purple blotch, and white rot the losses in the yield are quite severe. In the crop profile for onions in Texas (USA), the estimated yield loss in 2003 has reportedly been to the extent of 45% from Botrytis leaf blight and 65% from downy mildew. One feels compelled to ask if this is the situation of a developed nation what could be the status of developing ones like ours. Annual estimates for pesticide usage are to the tune of 1.56 pounds per acres (1, 184,700 acres treated) in California (www.pesticide info.org/). Using similar estimates for India where 790,736 acres of land are used for onion cultivation, 1,233,548.16 pounds of pesticide would be required to save the onion crop from diseases. This quantum will pose tremendous health and environmental issues. Alternative is to develop disease resistant varieties. For this, plant breeders can rely on wild species of *Allium*, for instance *A. roylei* and *A. fistulosum*.

Plants of *A. roylei* are locally used for their edible leaves, bulbs and dried inflorescences as a substitute of *A. cepa*. This is because all parts of the plant emit typical onion like odour. *A. roylei* though less explored and lesser known bears genes imparting resistance against various fungal diseases like downy mildew, late blight and anthracnose. Commonly known as jungle pyaz or gajna or panchali gajna, the species is found to be distributed in the Himalayan and sub-Himalayan ranges; Garhwal westwards between 6000-7000 ft. It is also found in the eastern Hindukush mountains of Pakistan and Afghanistan (Nasir, 1975). The species came into light when de Vries (de Vries, 1992) pointed out its importance in a Conference on Alliums, at Gatersleben, Germany. It is also reported as threatened and rare by various workers (Hajra, 1983; Walter and Gillet, 1998; Dar and Naqshi, 2001; Sharma and Gohil, 2008 and Pandey *et al*., 2008; Kohli and Gohil, 2009).

A. roylei has been considered as one of the most promising species for onion breeders (de Vries *et al*., 1992). Interspecific hybrids for *A. fistulosum* x *A. roylei* (Mc Collum, 1982) and *A. roylei* x *A. cepa* (Van deer Meer and de Vries, 1990) are on record. Authenticating extent of proximity between these species, these crosses enabled breeders to modify the genetic composition of some cultivated taxa. Valuable genes imparting resistance against downy mildew and leaf blight were successfully transferred from *A. roylei* to *A. cepa* (de Vries *et al*., 1992 and Scholten *et al*., 2007). Similarly anthracnose resistant gene, which is single and dominantly inherited, can also be transferred from *A. roylei* to *A. cepa* (Galvan *et al*., 1997). *A. fistulosum* constitutes another important species with higher dry matter content, are winter hardy and more pungent, flower earlier and have short flowering period than onion. Therefore, ample interest has been shown for successful introgression of genes from *A. fistulosum* to *A. cepa* also. Since direct crosses between the two could not be achieved, *A. roylei* was employed as a bridge species. Some of these agronomical traits including resistance to diseases such as onion leaf blight, pink root, anthracnose and to a pest like onion fly have been introgressed from *A. fistulosum* into *A. cepa* using this strategy (Khrustaleva and Kik, 2000). Interspecific crosses between *A. cepa* and *A. roylei* have yielded hybrids which are disease resistant (Simon, 2005). This has helped to eliminate the need of applying pesticides as partially or completely

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resistant cultivars have been obtained (Chuda and Adamus, 2009). Vu *et al* (2011, 2012) successfully produced novel alloplasmic male sterile lines in *A. cepa* harboring cytoplasm of *A. roylei*; and alien monosomic addition lines by introgression of genes from *A. roylei* into *A. cepa*. Interestingly, Scholten and his group, in Europe obtained hybrids which were completely resistant against downy mildew (Scholten *et al*., 2007).

All the breeding works mentioned above, were conducted on the Mussoorie germplasm (de Vries *et al*., 1992; Mc Collum, 1982 and Scholten *et al*., 2007) reportedly established at University of California, Davis (Mc Collum, 1982). Afterwards, de Vries also introduced few plants of the same during a conference on Alliums, at Gatersleben, Germany. We, at the University of Jammu have not been able to obtain this germplasm from Mussoorie inspite of some exploratory surveys conducted to procure the same. The populations worked out by the present workers so far from Bani, Mendhar and Gourwan regions of Jammu province (J&K) are complex translocation heterozygotes (Kohli, 2007,2013; Kohli and Gohil, 2009, 2011).

Nevertheless, nature has equipped these plants with an alternative means of survival. An individual plant has the potential to produce 4-5 new identical bulblets. Each bulblet forms a new plant on separation; if allowed to grow in undisturbed conditions. These plantlets survive well and grow into independent plants. Equipped with an efficient means of multiplication, the species can prove to be a good substitute for common onion during the periods of onion scarcity or of price hike. To ensure an effective utilization of this strategy and ensure availability of this following need to be implemented at the earliest:

1. Awareness among tribals residing in areas of occurrence about the importance of this species.
2. Utilization of wastelands at higher altitudes for its propagation since less maintenance is required.
3. Setting up of registered cooperative societies with members trained in cultivation, harvesting and post harvest management of the crop.

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SHORT COMMUNICATION

COMMUNITY ANALYSIS OF NEMIC FAUNA AROUND THE RHIZOSPHERIC ZONE OF *MANGIFERA INDICA*

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Abstract: The plant Nematodes are microscopic animal and interact with other living and non-living components of soil environment for their energy requirement. Apart from the numerical superiority of nematodes, the species numbers are also unbelievable very high, close on the heels to that of insects. The latter; as is commonly known, make up nearly 80% or about 8,00,000 known species out of a total of a little over one million species of all groups of animals. The remaining 20% or about 2,00,000 species also include nematode species, that are known so far. (Jairajpuri, 1990). The study of population dynamics of all those types of nematodes. Parasitic, free living and predatory held on to analyse number of different nematodes at a definite distance. Plant parasitic and predatory nematodes found mostly in deep zone, around soft roots but more number of free-living nematodes present in 20-30 cm depth and take part in the decomposition of dead organic materials. Hence the choice of specific depth that taken in this study because-free-living found abundantly in 20-30 cm depth and concerned with the study of those types of nematodes population.

Keywords : Mango Orchard, Nemic Fauna

INTRODUCTION

The plant nematodes are tiny, round-bodied, unsegmented worms and found in enormous number in soil environment. Nematodes are the major component of animalia. All the nematodes survive either of any physical phase, free-living in soil and parasitic in animal and plant both. Plant parasitic nematodes because of their hidden habitates, they are not very well understand outside the scientific community. They are usually microscopic, triploblastic, bilateral symmetrical, pseudocoelomate and dimorphic thread like invertebrate (Chitwood & Chitwood, 1950).

Nematodes interact with other living and non-living components of the soil environment for their energy requirement. On the basis of the feeding habits, the nematodes are categorized in parasitic, free-living and predatory (Overgaard & Neilson, 1949, Wieser, 1952b & Yeasts *et. al.*, 1971). Out of the total known nemic fauna, about 10% are plant parasitic are equipped with stylet through which they are able to feed on secondary roots of plant together with other plant pathogenic micro-organisms such as fungi.

The majority of nematode spp. are free-living in soil and water of these 50% are marine & 25% dwell in soil & fresh water. Generally fungal and bacterial feeding nematodes are the abundant trophic groups in forest and agricultural fields respectively (Popovici *et.al.* 1984). Most plants are probably infected by one or more species one time and yet to majority of them do not appear to be disease. Severe damage may result due to high infestation level in soil where the susceptible crops are planted.

Besides the fungal and bacterial feeder nematodes (Predatory) are also one of the components of the soil ecosystem. They feed on other nematodes and small creatures living in soil. Predatory nematodes can control the population of bacteria, fungal or root-feeding nematodes.

Nematodes play an important role in ecosystem function by regulating decomposition and also used as biomarker for monitoring the soil health (Beare *et.al.* 1992). They phytonematodes (Soil nematodes) typically have a patchy distribution within infested (Basker & Campell 1991; Goodell & Ferris 1980; Mc Sorley & Parado 1982). This characteristic affects the precision of sample estimates of nematode population densities (McSorley & Parrado 1982; Nor & Basker 1985) and accuracy of resulting yield-loss estimates in management advisory systems. Analysis of the relationship between variation in soil parameters and the irregular spatial patterns of plant-parasitic nematodes should lead to an improved understanding of how these organisms interact with the soil environment (Malhotra & Chaubey, 1990).

The vertical & horizontal distribution of nematodes must also be taken in to account because same species appear to prefer certain depths. Richter (1969) found that Trichodours occurred in greater numbers in deeper soil layer compound with species of Tylenchorhynchus and Paratylenchus. Flegg (1968) found that Xiphinema diversicaudatum & X. vuittienezi decreased in number with increasing depth where as longdours macrosoma increased with depth up to 70cm. Koen (1966) found that the seasonal variations from summer to winter and the consequent change of soil temperature and soil moisture influence the pattern of vertical distribution of Meloidogyne javanica in the soil.

MATERIAL AND METHOD

To study the different forms of nematodes (Nemic Fauna) around the rootzone of mango plants (*Mangifea indica*), at 20cm. vertical depth & 0-20cm.

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horizontal distance, select the mango orchards, were adjacent to Khurja City near district Bulandshahar U.P. The area of the orchard was of 1-5 acre and the plants were of the age of 20 years. There was 30 healthy plants selected in the orchard. Soil-samples (250 gm. each) were collected randomly fornightly with the help of augar at one vertical and one horizontal distance (0-20 cm each) and were stored in a well labeled polythene bags at temperature of 5-10^{0}C. Now the collected samples were extracted by Decanting & Sieving Method (Cobb, 1918).

Genera wise nematodes were counted from each sample. The isolated nematodes were killed with Fixative (FAG) to prevent twisting and contraction of tissues and remained in the Fixative for 48 hours. After dehydration of nematodes, 5-10 nematodes of equal-size were placed on glass slide in a single drop of Lactophenol in a wax block and slide to be cold. After that drawing have to be done and measurement was done with the help of Camera Lucida under $10\times10_x$ and $10\times40_x$ magnification of various parameters. viz. total body length, body width, stylet length and Oesophageal length, position of vulva in female, anterior & posterior and etc. was measured.

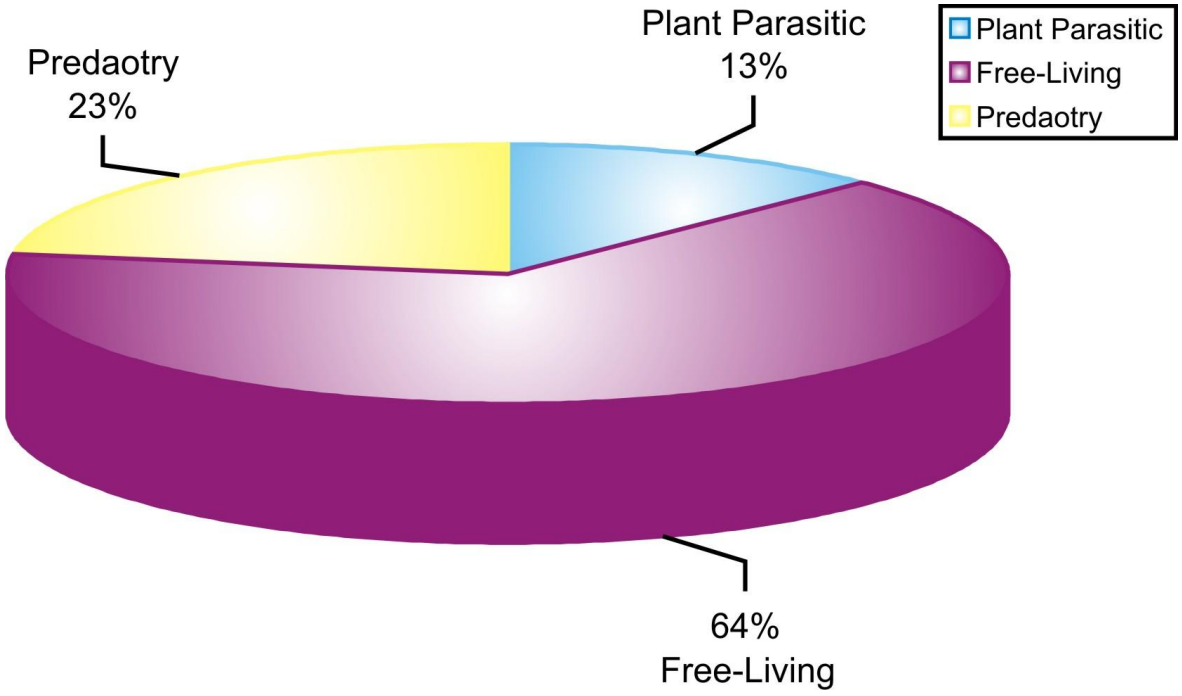
RESULT AND DISCUSSION

In the present investigation the distribution of nemic community around the rhizospheric rots of *Mangifera Indica* was not uniform. The free-living forms of nematodes were observed in enamors number near by the color-region of the host plant at 20 cm vertical and 0-20 cm horizontal distance, might be due to food resources and nature of host responce-like micro-organisms, specially bacteria, in which these free-living nematodes feed and perform their live activities (Wardle & Yeates, 1993). Due to such relationship in soil-ecosystem, most of the free-living forms shifted towards bacterial and fungal-feeding. In the present study the increased number of different communities can be correlated with the work of (Bradford *et.al.*, 2002).

The absolute frequency (A.F.), relative frequency (R.F.), relative density (R.D.) and prominence value (P.V.) were also much higher percentage at 20cm vertical depth and 0-20 cm. horizontal distance as compare to plant parasitic and predatory forms of nematodes.

Table: Distribution of different forms of nematodes occupying the soil environment at 20cm vertical depth and 0-20 cm horizontal distance around the root system of Mangifera Indica

S.No.	Nemic-Community	Nematode-Population/250 gm soil	Absolute Frequency %	Relative Frequency %	Relative Density %	Prominence Value	CDI
1.	P.P.	20.25	62.50	27.77	12.61	99.73	0.8738
2.	F.L.	104.12	87.50	38.88	64.87	606.84	
3.	Pre.	36.12	75.00	33.33	22.50	194.91	



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SHORT COMMUNICATION

EFFECT OF NITROGEN PHOSPHORUS AND SPACING ON GROWTH AND YIELD OF OKRA

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Abstract: An experiment was conducted to determine the effect of nitrogen phosphorus and spacing on growth and yield of okra. It revealed that application of 85 kg/ha. Nitrogen and phosphorus 60 kg/ha. produced significantly maximum plant height, internodes length, diameter of fruit and green fruit yield compared to 60 kg/ha, 35 kg/h and 40 kg/ha and 20 kg/ha phosphorus. The population responded significantly to spacing 60x30 cm and higher plant height, diameter of fruit, leaf length, width, weight per fruit highest recorded. But spacing of 30x30 cm length of inter node and green fruit per hectare were recorded. The green fruit yield could be economical and profitable with application 85 kg/ha and 60 kg phosphorus when planted 30x30 cm spacing of okra in western Uttar Pradesh condition.

Keywords: Nitrogen, Phosphorus, Effect, Growth, Okra

INTRODUCTION

Okra is annual vegetable crop in tropical and subtropical regions of the world. It is belongs to malvaceae family. Okra is one of the most important vegetable crops grown for its green fruits for vegetable purpose. It's more remunerative than the fresh leafy vegetable. Tender green fruits are cooked in curry. The root and stem are useful for clearing cane juice in preparation of jaggery. Okra fruits control goiter due to high iodine content, it is also used in manufacture of paper and cardboard. Consumable unripe okra fruit are source of carbohydrate, phosphorus, calcium protein, carotene, thiamine riboflavin niacin and vitamins C. Hence, the present study was conducted to study the combined effect of nitrogen, phosphorus and spacing levels on the growth and green fruit yield of in western Uttar Pradesh condition. The balance nutrition and optimum plant spacing are two important tools for obtaining higher fruits yields but the information on these two aspects of okra are meager. Therefore efforts were made to find out optimum and balanced fertilizer doses with suitable spacing for this okra variety.

MATERIAL AND METHOD

The field experiment was conducted at horticulture research farm A. S. College, Lakhaoti, Bulandshahr, UP. The experiment was laid out in a randomized block design with three level of nitrogen 60 kg (normal dose), 85 kg (normal dose +25) and 35 kg (normal dose -25 kg), three level of phosphorus viz. 40 kg (normal dose) 60 kg (normal dose+20 kg) and 20 kg (normal dose -20 kg) with three spacing (60x30 cm, 45x30 cm and 30x30 cm). Certified seeds of okra variety Pusa sawani procured from the national seed corporation (NSC) Ltd. New Delhi. Seeds were sown in Rabi season. The doses of nitrogen was applied in three Installment, half at the time of sowing as a basal dose, one fourth 30 days after sowing (DAS) as a first top dress and remaining one fourth of nitrogen was applied at the time of flowering as a second top dress. Phosphorus was applied as basal dressing through single super phosphate. Other intercultural operations were done time to time and data (Pool) were analyzed statically. The observations on fruiting and yield parameters were recorded by routine methods. The observations were recorded on the five randomly selected plants in each treatments plot.

RESULT AND DISCUSSION

Data showed that an application of 85 kg N/ha produced significantly maximum height of the plant (71.22 cm) followed by 60 kg N/ha (65.24 cm) and 35 kg N/ha (64.45 cm) respectively. Rastogi *et.al.* (1987), Hooda *et.al.* (1980) and Fageria *et.al.* (1992) also reported highest growth with higher dose of nitrogen. Maximum dose, phosphorus 60 kg/ha was significantly superior height of plant (67.57 cm) a followed by 40 kg P_2O_5 (65.73 cm) and 20 kg P_2O_5/ha (64.65 cm) respectively. In treatments a spacing of 60x30cm recorded maximum plant height and it was significantly superior to 45x30 cm 30x30 cm spacing. The results are accordance with finding of Hooda *et.al.* (1980). Okra crop which received higher nitrogen 85 kg/ha (43.12) and 60 kg P_2O_5 /ha (44.25) took minimum number of days to 50% flowering compared to 60 kg N/ha (45.61) and 40 kg P_2O_5/ha (45.56) and 35 kg N/ha (47.12) and 20 kg P_2O_5 (46.05) followed by respectively. Plants grown under various spacing did not significantly differ in

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respect of number of days for 50 % flowering in the years of experimentation.

Higher dose of nitrogen (85 kg/ha) produced significantly maximum length of internodes (3.32 cm) followed by 60 kg N/ha (2.83 cm) and 35 kg N/ha (2.32 cm) respectively. Maximum dose of phosphorus 60 kg/ha produced maximum length of internodes (3.02 cm) followed by 40 kg/ha (2.83) and 20 kg/ha (2.61) respectively. In closer spacing of 30x30 cm recorded maximum length of internodes (2.49 cm) followed by 60x30 cm (2.80 cm) and 45x30 (2.73 cm).

Highest rate of nitrogen and phosphorus application 85 kg/ha and 60 kg length of fruit (14.70 cm), (13.90 cm) followed by 60 kg N/ha (13.26 cm), 35 kg N/ha(11.64cm) and 40 kg P_2O_5/ha (13.26 cm) and 20 kg P_2O_5/ha (12.43 cm). Wider spacing 60x30 cm recorded maximum length (13.41cm) fruit length and was superior to 45x30 cm (13.28 cm) and 30x30 cm (13.10 cm) respectively.

Table 1. Effect of Nitrogen Phosphorus and spacing on growth and yield of okra (at the edible stage)

Treatments	Plant *height	Days to 50% flowering	Length of internodes (cm)	No.of node which Ist flowering	Diameter of fruits (cm)**	Lengthof fruits (cm)**	weight /fruit** (g)	Green fruits yield q/ha
Level of Nitrogen Kg/ha								
Normal dose(60)	65.24	45.61	2.83	3.91	1.71	13.27	7.32	88.56
Normal dose(60) +25	71.22	43.12	3.32	4.53	1.93	14.70	8.82	112.20
Normal dose(60) -25	61.45	47.12	2.32	2.96	1.39	11.64	5.92	63.14
CD at 5%	2.11	1.02	0.06	0.08	0.05	0.30	0.19	13.86
Level of Phosphorus Kg/ha								
Normal dose(40)	65.73	45.56	2.83	3.81	1.69	13.26	7.17	86.37
Normal dose(40)+20	67.57	44.25	3.02	4.11	1.81	13.90	7.99	97.82
Normal dose(40)-20	64.65	46.05	2.61	3.48	1.52	12.43	6.86	80.13
CD at 5%	2.11	1.03	0.06	0.08	0.05	0.30	0.19	13.86
Level of Spacing (cm)								
60 x30	66.33	45.73	2.80	3.62	1.71	13.41	7.46	61.67
45 x30	65.87	44.99	2.73	3.53	1.66	13.28	7.41	82.54
30 x30	65.74	45.13	2.94	4.25	1.62	13.10	7.13	120.10
CD at 5%	NS	NS	NS	0.08	0.05	0.30	0.19	13.86

* = 80 Days after sowing

**= at the edible stage

The highest rate of nitrogen application 85 kg N/ha produced maximum diameter (1.93 cm) of fruits followed by 60 kg N/ha (1.71 cm) these were significantly superior to 35 kg/ha (1.39 cm) with increase rate nitrogen application there was increased fruits diameter.

Diameter of fruits affected significantly by phosphorus. Higher dose of phosphorus application 60 kg/ha produced maximum fruits diameter (1.81cm) followed by 40 kg P_2O_5/ha (1.69 cm) and 20 kg P_2O_5/ha (1.52cm) respectively. In wider spacing of 60x30 cm recorded maximum fruit diameter (1.71 cm) and it was superior to 45x30 cm (1.66 cm) and 30x30 cm (1.62).similar result were also reported by Pandey *et.al* (1976). The maximum weight per fruit (8.82 g) were recorded 85 kg N/ha followed by 60 kg N/ha (7.32 g) and 35 kg N/ha (5.92) respectively. Wider spacing 60x30 cm recorded maximum weight per fruit (7.46 g) and superior to 45x30 cm (7.41 g) and 30x30 cm (7.13g) respectively. The highest rate of phosphorus application (60kg/ha) produced maximum weight per fruit (7.99 g) followed by 40 kg P_2O_5/ha. (7.17 g) and both were significantly superior to 20 kg P_2O_5 /ha (6.86 g) .With increase in rate of phosphorus application the weight was increased per fruit.

The highest rate of nitrogen application 85 kg/ha produced maximum green fruits yield (112.20 q/ha) followed by 60 kg N/ha (88.56 q/ha) and both were significantly to superior 35 kg N/ha (63 kg/ha). The result has been also reported by Gandhi *et.al.* (1990), Hooda *et.al*. (1984) Mani *et.al.* (1981).

Maximum green fruit yield per hectare was recorded when 60 kg P_2O_5 /ha (97.822) was applied and it was significantly superior to 40 kg P_2O_5/ha (86.67q/ ha) and 20 kg P_2O_5/ha (80.13 q/ha).similar result were also reported Mani *et.al* (1981), Hooda *et.al.* (1980), Sharma *et.al.* (1973) and Singh *et.al.* (1967). Increase in rate of nitrogen and phosphorus application the fruit yield was increased. In closer spacing of 30x30 cm recorded highest green fruit yield and it was significantly superior to 45 x30 m (82.54 q/ha) and 60x30 cm (61.67 q/ha) spacing ,due to more plant in 30x30 cm unit area compared to 45x30 cm and 60x30 cm spacing. These result were also reported by Randhawa (1967), Pandey *et. al.* (1979) Khan and Jaiswal (1988).

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