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Contents

RESEARCH ARTICLE

OBSERVATIONS ON TEMPERATURE VARIATION IN ALPINE ZONE OF UTTARAKHAND: A CASE STUDY OF TUNGNATH

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Abstract: The metrological data for maximum, minimum and soil temperature was recorded at 3600 mt. altitude during 2015-16 for Ph.D. programme under the topic "Phenological response of four Rhododendron species with reference to climate change" and compared with the data recorded for same parameters at the same altitude and place collected during June to September, 1979 by High Altitude Plant Physiology Research Centre Srinagar. In weekly temperature recording it is observed that the maximum air temperature has increased from 2 to 4 ºC as well as the minimum temperature has also decreased up to 2 to 3ºC within a span of 35 years. However, soil temperature has shown the increase of about 2 to 3 ºC. It indicates that though the variation in mean temperature does not increase significantly but the difference between maximum and minimum temperature has increased drastically. This clearly indicates that the variation in temperature which is responsible for all the metabolic processes in plants and plays a significant role in plant adaptation has significantly increased in both sides. Which means that plants has to face both extreme low as well as high temperatures, which may cause loss of those species which has low adaptation potential to these temperature extremes.

Keywords: Alpine Zone, Metrological data, Temperature, Uttarakhand

INTRODUCTION

In today's scenario the subject of climate change continues to be a topic of hot debate at global conventions, world summits & International Conferences. Change in climate is not an endemic phenomenon which restricted to a particular region instead of that its spreading globally which is a big alarm to the mankind and needs a continuous vigilant.

Many evidences have been gathered to depict that climate change is taking place. The main reason behind this is the continuous emission of green house gases into the atmosphere through anthropogenic activities. Over the past 100years the global average temperature has increased by approximately 0.6ºC and is projected to rise at a rapid rate. The third assessment report from the IPCC projects that the earth's average surface temperature will increase by 1.4 to 5.8 ºC between 1990 and 2100, if no major efforts are undertaken to reduce the emission of green house gases.

Climatic conditions determine where individual species of plants can survive and reproduce. The species in an ecosystem are in general strong adapted to the long prevailing climatic pattern but many of them are vulnerable to modest changes due to low adaptation potential.

In the present study site Tungnath where the five species of Rhododendron are exist as a dominant vegetation of this region showed many indications of the change in the phenology like bud break, flowering and reproduction may be because of the change in climatic condition. To find out the changes in temperature both air and soil, rainfall/snowfall and light intensity, the metrological data of these parameters was recorded round the year at weekly interval during 2009 -10 and presented in this paper. Since, the temperature data of 1979 from June to September was available; this was considered to find out the temperature variation within the interval of 30 years at the same place and altitude.

MATERIALS AND METHOD

The present study was carried out at 3600 mt. altitude above mean sea level at Chandrashilla, Tungnath area of District Rudraprayag, Uttarakhand. The metrological data was collected 2015 – 16 at weekly interval and compared with the metrological data record available for the same place from June to September 1979 collected by High Altitude Plant Physiology Research Centre Srinagar Garhwal. The maximum - minimum air temperature and soil temperature were recorded by using maximum - minimum thermometer and soil thermometer for soil temperature. The observations of air and soil temperature during 2015-16 are given in Fig. 1 (a, b, c) however; the comparison of this data available from June to September is given in Fig. 2(a, b, c).

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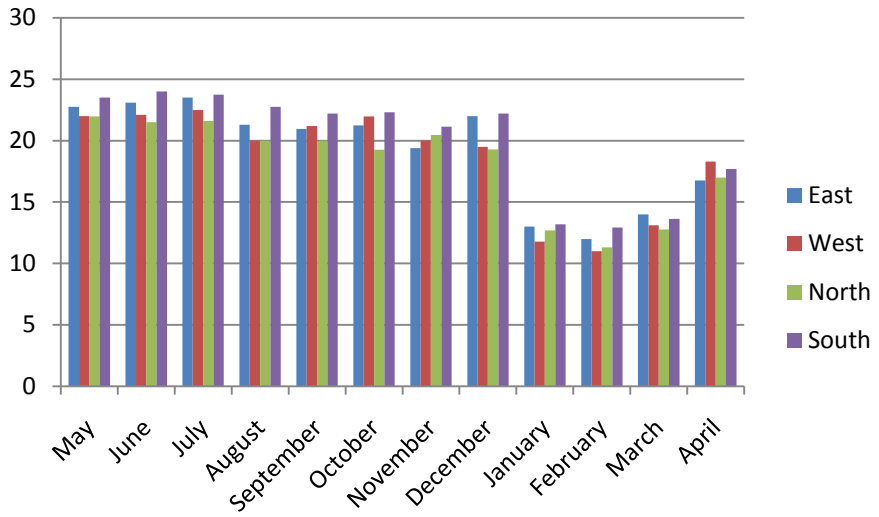
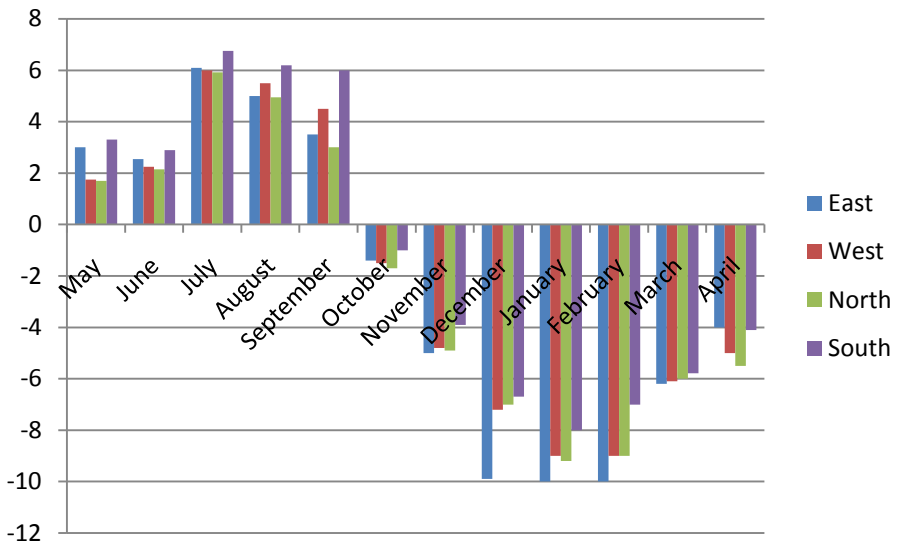


Fig.1 (a) Maximum Temperature



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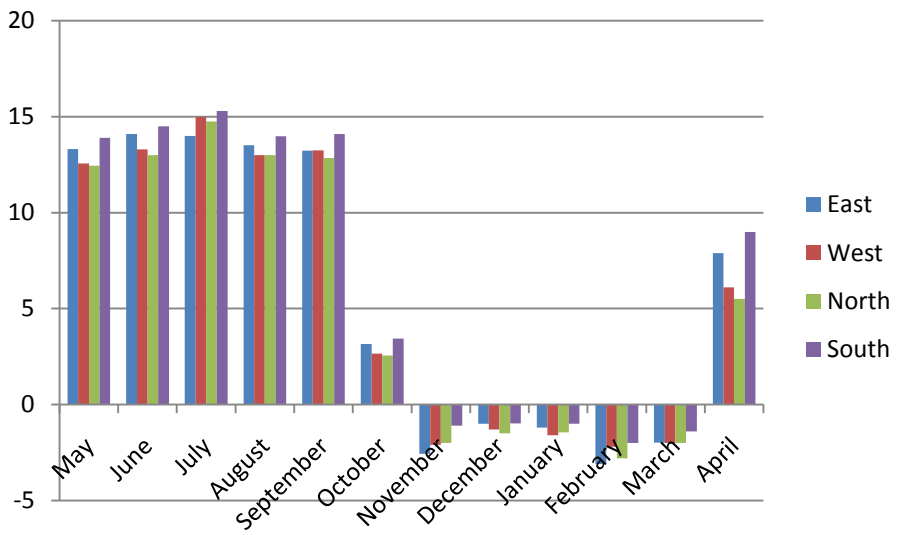

Fig.1 (c) Soil Temperature

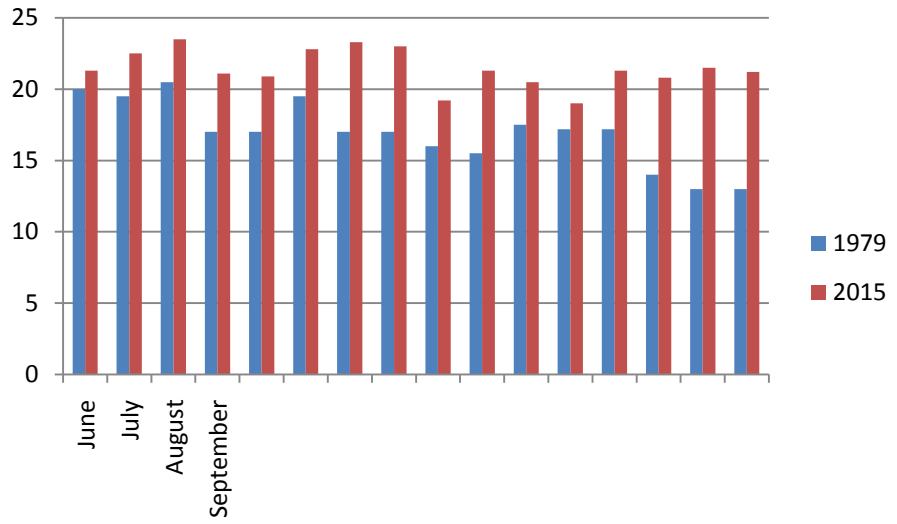

Fig.2 (a) Maximum Temperature

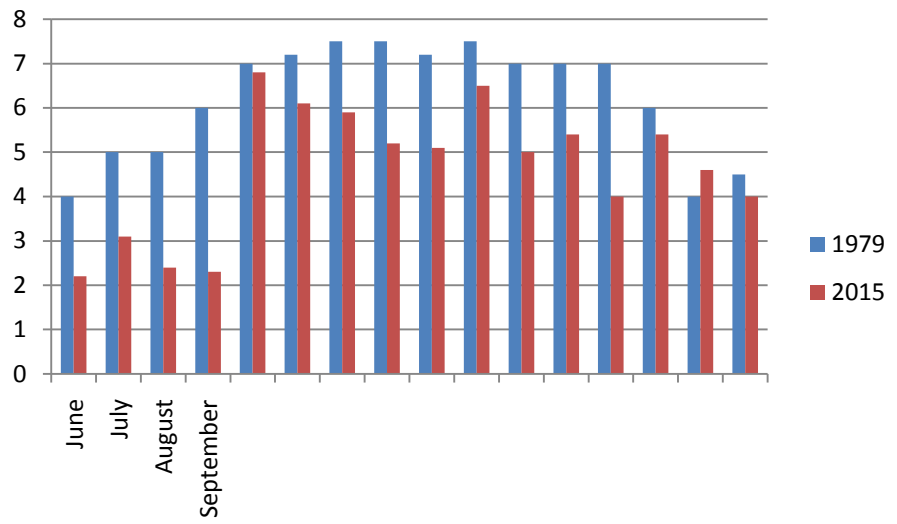

Fig.2 (b) Minimum Temperature

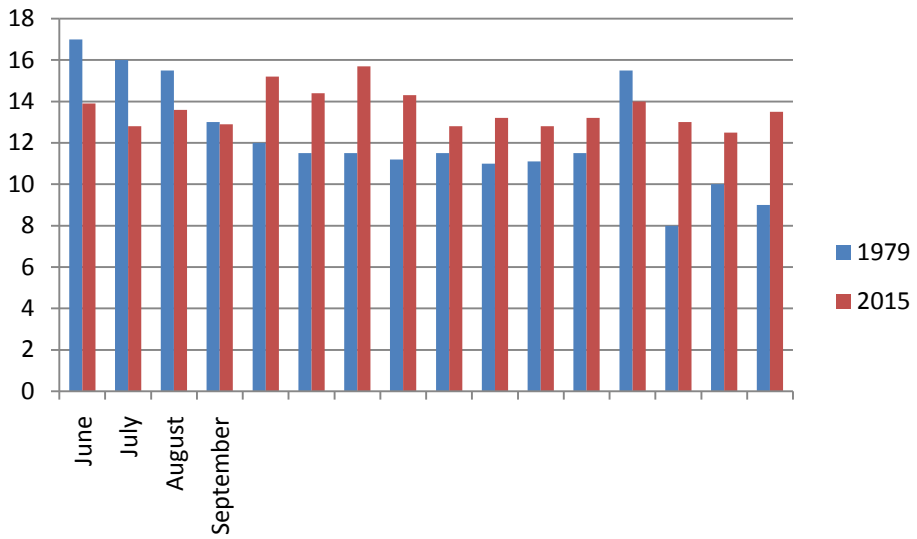

Fig.2 (c) Soil Temperature

RESULTS AND DISCUSSION

The data collected from June 2015 to September 2015 was compared with data recorded by S. Nautiyal in 1979. During 2015 the highest temperature was recorded in the third week of June (23.5 ºC) followed by third week of July (23.3 ºC), were as the lowest, maximum temperature was recorded in the fourth week of August (19 ºC) and the third week of September (19 ºC) followed by first week of August (19.2 ºC). However during 1979 the highest maximum temperature was recorded in the third week of June (20.5 ºC) followed by the first week of June (20 ºC). However on the monthly basis the maximum temperature was found in 2015 in the month of July (22.5 ºC) followed by the June (22.1 ºC), and in 1979 maximum temperature was recorded in the month of June (19.25ºC) followed by July (17.62 ºC) lowest maximum temperature was recorded in the month of August (20ºC) followed by September (21.2 ºC) , in 1979 lowest maximum temperature was recorded in the month of September (13.3 ºC) followed by August (16.55 ºC). Highest difference in maximum temperature during 1979 to 2015 was found (7.9 ºC) in the month of September followed by July (4.87ºC). However, the highest values of minimum temperature was recorded in 2015 in the first week of July (6.8 ºC) followed by the second week of August (6.5ºC) lowest minimum temperature was recorded in first week of June (2.2 ºC) followed by the last week of June (2.3ºC), however in 1979 the highest minimum temperature was recorded in third week of July (7.5 ºC) followed by first week of August (7.2 ºC). However lowest minimum temperature was recorded in 1979 in the first week of June (4 ºC) followed by the last week of September (4.5 ºC). Whereas on the monthly basis in 2015 highest minimum temperature was recorded in the month of July (6 ºC) followed by August (5.5ºC), and the lowest temperature was recorded in the month of June (2.5 ºC) followed by September (4.5 ºC) and in 1979 highest minimum temperature was recorded in the month of July (7.3 ºC) followed by August (7.17 ºC), and the lowest minimum temperature was recorded in the month of September (5.37 ºC) followed by the June (5 ºC).In 2015 the highest soil temperature was recorded in the third week of July (15.7 ºC) and the minimum soil temperature was recorded third week of September (12.5 ºC) followed by the fourth week of June (12.8 ºC).However during in 1979 maximum soil temperature was recorded in the first week of June (17 ºC) followed by the second week of June (16 ºC) and the minimum soil temperature was recorded in the second week of September (8 ºC) followed by last week of September (9 ºC) .On monthly basis in 2015 the maximum temperature was recorded in the month of July (14.9 ºC) followed by the June (13.3ºC) and in 1979 the maximum temperature is recorded in the month of June (15.37 ºC) and minimum temperature was recorded in the month of September(10.62 ºC) followed by August (11.27 ºC) and the highest difference during 1979-2015 in soil temperature was recorded in the month of July (3.87 ºC) followed by September (3.57 ºC).

The highest increase in winter mean maximum temperature (across India) was obtained for Himachal Pradesh (plus 0.06 degree Celsius per year) it said. Uttarakhand, too, showed a significant increase (plus 0.02 degree Celsius per year) in winter mean maximum temperature. This clearly indicates that the variation in temperature which is responsible for all the metabolic processes in plants and plays a significant role in plant adaptation has significantly increased in both sides. Which means that plants has to face both extreme low as well as high temperatures, which may cause loss of those species which has low adaptation potential to these temperature extremes. Significant upward shift of plant species have already been reported from many parts of the globe due to warming (Cannone *et al*., 2007; Kelly *and* Goulden, 2008). Most importantly, it is predicted that impacts of global climate change will be more pronounced in higher altitude (Beniston, 2003). However in the present study site due to the warming *Rhododendron campanulatum* proceeding upward from subalpine (3200 mt masl.) to alpine (3800 mt.masl) zone. Signatures of Climate Change have already begun to appear in the Kumaun Himalayan region in the form of early flowering/fruiting of native trees such as *Rhododendron arboreum* (Gaira *et al*., 2014), here in our study in the Garhwal himalaya same pattern was observed i.e in all four species of Rhododendron Floral buds break was first noticed on set of Spring as soon as the snow melt above (9,000 ft) and observed early flowering/fruiting, seed setting, seed dispersal. Various studies suggest that warming in the Himalayas has been much greater than the global average of 0.74°C over the last 100 years (IPCC 2007). Same trend was observed in our study that temperate, sub-alpine and alpine temperature rose up to 2-3 ºC within 35 years. The All-India rainfall data do not show any significant trend in monsoon rains, however, there are some regional variations. A trend of about 10 to 12% (of the normal) increase in monsoon rains were reported along the west coast, northern Andhra Pradesh and north-western India during the last century. A decreasing trend of about 6 to 8% is observed over the last 100 years over eastern Madhya Pradesh, North-Eastern India and some parts of Gujarat and Kerala (NAPCC, 2008). While in alpine zone at our study site it was also higher (105 cm) during monsoon and minimum (5-6 cm) during winter or after monsoon.The report in Research Communications journal that they analyzed the long-term temperature data of the region for the previous 40 years (1971-2011) and found a comparatively small but significant increase in mean maximum temperature of 0.5 ºC over the period.in

Johannesburg, South Africa, where it is summer, the air temperature can reach 35°C (95° F), and in Fairbanks, Alaska at that same time of year, it is the middle of winter and air temperatures might be -35°C (-31° F) however in alpine region of Garhwal Himalaya it is in summer can reach (26.32^{o}C) and during December-February minimum temperature (-10.8 ^{o}C).

It is interesting to note that during last 35 years the maximum temperature in Alpine zone has increased but at the same time the minimum temperature has decreased. Therefore, though the mean temperature of maximum and minimum does not change much but the gap between maximum and minimum values has increased. It means that the plants have to face both maximum and minimum extremes temperature. Those species having low adaptation to these temperature extremes may be lost in future. The soil temperature in general has shown increasing trend by 2 to 3 ºC in last 30 years. Increasing soil temperature to some extend may help root growth and ultimately shoot growth also and also provide opportunity to soil microbes to multiply and work vigorously for their diverse functions. Abrupt temperature variation though may not be much destructive to Alpine vegetation keeping in view of their perennial nature but certainly it can affect the phenology of most of the species as most of the metabolic processes are temperature governed. The bud break (both flower and vegetative bud), flowering, new shoots and leaf initiation, pollination, fruit and seed development, seed dispersal, seed germination and survival of these regular activities may be effected which may lead to loss of some species, introduction of new species and gradual shift of vegetation.

Maximum Temperature

Month	Week	1979	2015	Difference
June	1	20 ºC	21.3 ºC	1.3 ºC
	2	19.5 ºC	22.5 ºC	3 ºC
	3	20.5 ºC	23.5 ºC	3 ºC
	4	17 ºC	21.1 ºC	4.1 ºC
Average		19.25 ºC	22.1 ºC	2.85 ºC
July	1	17 ºC	20.9 ºC	3.9 ºC
	2	19.5 ºC	22.8 ºC	3.3 ºC
	3	17 ºC	23.3 ºC	6.3 ºC
	4	17 ºC	23 ºC	6 ºC
Average		17.62 ºC	22.5 ºC	4.87 ºC
August	1	16 ºC	19.2 ºC	3.2 ºC
	2	15.5 ºC	21.3 ºC	5.8 ºC
	3	17.5 ºC	20.5 ºC	3 ºC
	4	17.2 ºC	19 ºC	1.8 ºC
Average		16.55 ºC	20 ºC	3.45 ºC
September	1	17.2 ºC	21.3 ºC	4.1 ºC
	2	14 ºC	20.5 ºC	6.8 ºC
	3	9 ºC	19 ºC	12.5 ºC
	4	13 ºC º	21.2 ºC	8.2 ºC
Average		13.3 ºC	21.2 ºC	7.9 ºC

Minimum Temperature

Month	Week	1979	2015	Difference
June	1	4.00 ºC	2.2 ºC	1.8 ºC
	2	5.00 ºC	3.1 ºC	1.9 ºC

	3	5.00 ºC	2.4 ºC	2.6 ºC
	4	6.00 ºC	2.3 ºC	3.7 ºC
Average		5.00 ºC	2.5 ºC	2.5 ºC
July	1	7.00 ºC	6.8 ºC	0.2 ºC
	2	7.2 ºC	6.1 ºC	1.1 ºC
	3	7.5 ºC	5.9 ºC	1.6 ºC
	4	7.5 ºC	5.2 ºC	2.3 ºC
Average		7.3 ºC	6 ºC	1.3 ºC
August	1	7.2 ºC	5.1 ºC	2.1 ºC
	2	7.5 ºC	6.5 ºC	1 ºC
	3	7.0 ºC	5 ºC	2 ºC
	4	7.00 ºC	5.4 ºC	1.6 ºC
Average		7.17 ºC	5.5 ºC	1.67 ºC
September	1	7.00 ºC	4 ºC	3 ºC
	2	6.00 ºC	5.4 ºC	0.6 ºC
	3	4.00 ºC	4.6 ºC	0.6 ºC
	4	4.5 ºC	4 ºC	0.5 ºC
Average		5.37 ºC	4.5 ºC	1.17 ºC

Soil Temperature

Month	**Week**	**1979**	**2015**	**Difference**
June	1	17.00 ºC	13.9 ºC	3.1 ºC
	2	16.00 ºC	12.8 ºC	3.2 ºC
	3	15.5 ºC	13.6 ºC	1.9 ºC
	4	13 ºC	12.9 ºC	0.1 ºC
Average		15.37 ºC	13.3 ºC	2.07 ºC
July	1	12.00 ºC	15.2 ºC	3.2 ºC
	2	11.5 ºC	14.4 ºC	2.9 ºC
	3	11.5 ºC	15.7 ºC	4.2 ºC
	4	11.2 ºC	14.3 ºC	3.1 ºC
Average		11.55 ºC	14.9 ºC	3.35 ºC
August	1	11.5 ºC	12.8 ºC	1.3 ºC
	2	11.00ºC	13.2 ºC	2.2 ºC
	3	11.1 ºC	12.8 ºC	1.7 ºC
	4	11.5 ºC	13.2 ºC	1.7 ºC
Average		11.27 ºC	13 ºC	1.72 ºC

September	1	15.5 ºC	14 ºC	1.5 ºC
	2	8.00 ºC	13 ºC	5 ºC
	3	10.00 ºC	12.5 ºC	2.5 ºC
	4	9.00 ºC	13.5 ºC	4.5 ºC
Average		10.62 ºC	13.25 ºC	3.37 ºC

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RESEARCH ARTICLE

EFFECT OF PLANT GROWTH REGULATORS ON GROWTH PARAMETERS OF SWEET POTATO (*IPOMOEA BATATAS* (L.) LAM.)

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Abstract: A field experiment was carried out during *kharif*2016-17 at Kittur Rani Channamma College of Horticulture, Arabhavi (Karnataka) to study the effect of growth regulators on growth parameters of sweet potato [*Ipomoea batatas* (L.) Lam.]. The results revealed that the spraying of GA_3 @ 100 ppm (T_3) showed significantly highest Vine length (125.50 cm), Petiole length (26.83 cm) and Significantly highest leaf area (87.43 cm^2) was recorded with the combination of GA_3 100 ppm plus CCC 250 ppm (T_{10}), which was on par with GA_3 at 100 ppm (85.18 cm^2),

Keywords: Sweet potato, Plant growth regulators, Growth parameters

INTRODUCTION

Sweet potato [*Ipomoea batatas* (L.) Lam.] is an important tuber crop belonging to the family Convolvulaceae. It is an important starchy vegetablecrop in tropics and sub tropics. It is mainly grown as oneof the supplementary food crops to meet the requirementsof carbohydrates and also to provide raw materials formanufacture of starch, alcohol, lactic acid, vinegar etc. The nutrition of sweet potato in human diet is quite appreciable since, it provides high quantity of starch, substantial amount of vitamins (A, B and C) (Hung *et al.* 1999), minerals and trace elements compared to cereals. It would be a good substitute for rice and wheat (Thakur, 1975). It also contains considerable amount of beta-carotene (5.40 to 20.00 mg/100g) and sugar content. In India sweet potato is grown utilizing the-monsoon rains during *Kharif* (June-July) and with supplemented irrigation during Rabi (October-November).In India, sweet potato is being cultivated in almost all the states with an area of 111 ha, with a production of 1450 metric tonnes and productivity of 10.4 MT/ha (Anonymous, 2015). India accounts for about 68% of the total production of South Asia followed by 27% in Bangladesh and about 5% in Sri Lanka. In India, Sweet potato is cultivated mainly in Odisha, Uttar Pradesh, West Bengal, Bihar, Karnataka, Andhra Pradesh, Tamil Nadu and Kerala.

The role of plant growth substances in the physiology of plant is one of the most interesting chapters in the science. The plant growth substances are organic compounds, other than nutrients which in small concentration influence the physiological processes of plants. They have been used for various beneficial effects such as promoting plant growth, increasing number of flowers, fruit size and inducing early and uniform fruit ripening.GA_3 has a major effect on growth and development activating the entire metabolic activities of many crops. $GA_3$is one of the important growth regulators that stimulate vegetative growth (Singh and Rajodia, 2001), yield (Khan *et al.,* 2002) and sugar content (Babu, 2000). Cycocel (CCC) a new quartemary ammonium growth retardant is the most effective. It interferes with many of the metabolic activities. Reduction of plant height with subsequent increase in branching and yield by the application of CCC was reported by Devi (2002). Increase in chlorophyll content (Volkova, 1985), yield (Amutha and Rajendran, 2001), (Shrivastava*et al.,* 2001) was also reported due to CCC application.

MATERIALS AND METHODS

The field experiment was conducted at the Kittur Rani Channamma College of Horticulture, Arabhavi, Gokak Taluk, Belgaum district of Karnataka state during the *Kharif -2016*. Arabhavi is situated in northern dry zone of Karnataka state at 16^0 13’ 39.6” north latitude, 74^0 50’ 13.5” east longitude and at an altitude of 612.03 m above the mean sea level.Arabhavi, which lies in Zone-3 of Region-2 of agro-climatic zones of Karnataka, is considered to have the benefit of both South-West and North-East monsoons. The average rainfall of this area is about 530 mm, distributed over a period of five to six months (May-October) with peak (226.10 mm) during September. The area receives water from Ghataprabha Left Bank Canal from mid-July to mid-March. During the experimental period, the mean minimum temperature varied from 11.80^0 C (December 2016) to 23^0 C (August 2016), whereas the mean maximum temperature varied from 26.10^0 C (December 2016).

The experiment was laid out in Randomized block design and replicated thrice.Vine cuttings of 15-20 cm length were planted at a spacing of 60 x 30 cmand 5-7 cm depth. Standard recommended cultural practices were followed during the entire crop grown period.The experiment consisted of different PGR concentrations (GA_3 @ 25, 50 and 100 ppm, CCC @ 100, 250 and 300 ppm and IBA @ 100 and 200 ppm and control). In each treatment, the plants were

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sprayed twice at 45 and 60 days after transplanting. The data on vegetative growth parameters were recorded and analyzed statistically.The experimental data collected on various growth, yield and quality aspects were subjected to Fisher's method of analysis of variance (ANOVA) as per methods outlined by Panse and Sukhatme (1967). The critical difference (CD) was calculated wherever the 'F' test was found significant. The data were analyzed and presented with the level of significance at 5 per cent.

RESULTS AND DISCUSSION

Fresh vine length

It is evident from the data that the vine length was significantly influenced by growth regulators and the treatments differed significantly among themselves at various growth stages except at 30 DAP and presented in Table -1.

Among different treatments, GA_3 at 100 ppm (T_3) was recorded highest vine length (125.50 cm), which was on par with combination of GA_3 at 100 ppm plus CCC at 250 ppm (T_{10}) (119.00 cm), combination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) (116.17 cm) and IBA at 200 ppm (T_8) (108.33 cm), whereas minimum vine length (73.17 cm) was observed in control (T_{11}) at 60 DAP. Vine length noticed at 90 DAP ranged from 113.10 to 169.83 cm.Significantly highest vine length (169.83 cm) was recorded in GA_3 at 100 ppm (T_3), which was on par with GA_3at 100 ppm plus CCC at 250 ppm (T_{10}) (154.95 cm) andcombination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) (146.75 cm). In control (T_{11}) the lowest vine length (113.10 cm) was observed.

The trend observed in respect of vine length at harvest (120 DAP) of crop was similarto those observed at earlier stages. Significantly highest vine length (221.72 cm) was recorded in GA_3 at 100 ppm (T_3),which was on par with combination of GA_3at 100 ppm plus CCC at 250 ppm (T_{10}) (213.52 cm) and combination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) (205.48 cm), whereas minimum vine length (158.09 cm) was observed in control. The increase in vine lengthby GA_3 treatment may be due cell division. GA_3 has been found to increase the cell wall plasticity and also thus creating water diffusion pressure deficit, which result in water uptake, thereby causing cell elongation followed by cell division as suggested by Randhawa (1971). However, the response to GA_3 in terms of cell division and cell elongation depends up on nature of tissues and the balance of the different kinds of growth substances. Similar responses of GA_3 were earlier reported by Tohamy*et al.* (2015) in sweet potato, Natesh *et al.* (2005) in chilli, Sengupta *et al.* (2008) in ginger.

Petiole length (cm)

Significantly higher petiole length (26.83 cm)was recorded in GA_3 at 100 ppm (T_3), which was on par with treatment combination of GA_3at 100 ppm plus CCC at 250 ppm (23.86 cm) (T_{10}), combination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) (23.41 cm). The minimum petiole length (18.25 cm) was observed incontrol (T_{11}).

Petiole length recorded at 90 DAP ranged from 21.12 to 29.86 cm.Significantly highest petiole length (29.86 cm) was recorded in GA_3 at 100 ppm (T_3), which was on par with treatment combination of GA_3 at 100 ppm plus CCC at 250 ppm (T_{10}) (27.98 cm),combination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) (26.92 cm). In control (T_{11}) the lowest petiole length (21.12 cm) was observed. The trend observed in respect of petiole length at harvest (120 DAP) of crop was similarto those observed at earlier stages.Significantly highest petiole length (31.99 cm) was recorded in GA_3 at 100 ppm (T_3), which was on par with combination of GA_3 at 100 ppm plus CCC at 250 ppm (T_{10}) (29.54 cm) and whereas minimum petiole length (24.38 cm) was observed in control (T_{11}). The promotion of growth either in terms of increase the petiole length due to GA_3 has been thought to be by increasing plasticity of the cell wall followed by hydrolysis of starch to sugars which lowers the water potential of cell, resulting in the entry of water into the cell causing elongation. These osmotic driven responses under the influence of gibberellins might have attributed to increase in photosynthetic activity, accelerated translocation and efficiency of utilizing photosynthetic products, thus resulting in increased cell elongation and rapid cell division in the growing portion (Sargent, 1965).These results are in conformity with the findings of Singh and Choudhary (1989) in watermelon and Rao*et al.* (2017) in sweet potato (Table 2).

Leaf area (cm^2)

Significantly higher leaf area (77.20 cm^2)was recorded with combination of GA_3 at 100 ppm plus CCC at 250 ppm (T_{10}), which was on par with single treatment of GA_3at 100 ppm (73.50 cm^2), combination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) (71.15 cm^2) and IBA at 200 ppm (T_8) (68.30 cm^2). The minimum leaf area (61.42 cm^2) was resulted incontrol (T_{11}) at 60 DAP. Significantly highest leaf area (87.43 cm^2) was recorded with the combination of GA_3 100 ppm plus CCC 250 ppm (T_{10}), which was on par with GA_3at 100 ppm (85.18 cm^2), combination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) and GA_3 at 50 ppm (T_2). In control (T_{11}) the lowest leaf area (69.15 cm^2) was observed at 90 DAP.

The trend observed in respect of leaf area at harvest (120 DAP) of crop was similarto those observed at earlier stages. Combination of growth regulators GA_3at 100 ppm plus CCC at 250 ppm (T_{10}), recorded significantly highest leaf area (98.48 cm^2), followed by GA_3@ 100 ppm (T_3) (93.60 cm^2),whereas minimum leaf area (78.11 cm^2) was observed in control.

The promotion of growth either in terms of increase the leaf area due to GA_3 has been thought to be by

increasing plasticity of the cell wall followed by hydrolysis of starch to sugars which lowers the water potential of cell, resulting in the entry of water into the cell causing elongation.These results are in conformity with the findings of Singh and Choudhary (1989) in watermelon, Emongor (2007) and Chatterjee and Choudhuri (2012) in cowpea.

The highest diameters of fresh tubers (7.42 cm) was recorded in combination of GA_3 at 100 ppm plus CCC @ 250 ppm(T_{10}), which was on par with single treatment of CCC at 300 ppm (T_6) (7.27 cm).Whereas the lowest diameters of fresh tubers (3.78 cm) was reported in control (T_{11}).Similar response of CCC increase the girth of root tuber was earlier reported by Abdul and Kumaran (1980),Tohamy*et al.*(2015),Shee (1983)in sweet potato, Mohamed and Anbu (1996) in radish and Jirali*et al.* (2008) in ginger.

Table 1. Vine length (cm) of sweet potato at different stages of growth as influenced by different plant growth regulators

Sl. No.	Treatments	Vine length (cm)			
		30 DAP	60 DAP	90 DAP	120 DAP
1.	T_{1-} GA_3 @ 25 ppm	51.12	92.17	127.29	173.33
2.	T_2- GA_3 @ 50 ppm	50.02	100.51	138.02	187.47
3.	T_3- GA_3 @ 100 ppm	50.42	125.50	169.83	221.72
4.	T_4- CCC @ 200 ppm	49.00	106.83	145.24	191.86
5.	T_5- CCC @ 250 ppm	48.45	95.67	132.17	183.75
6.	T_6- CCC @ 300 ppm	47.30	90.83	126.08	174.40
7.	T_7- IBA @ 100 ppm	51.31	93.73	131.38	175.83
8.	T_8- IBA @ 200 ppm	47.28	108.33	143.67	185.09
9.	T_9- Combination of GA_3 @ 50 ppm + IBA @ 200 ppm	50.11	116.17	146.75	205.48
10.	T_{10}- Combination of GA_3 @ 100 ppm + CCC @ 250 ppm	47.20	119.00	154.95	213.52
11.	T_{11}- Control	54.35	73.17	113.10	158.09
	S.Em±	**2.90**	**7.43**	**8.80**	**8.58**
	C. D. at 5%	**N.S**	**21.94**	**25.97**	**25.31**
	C.V	**10.11**	**12.63**	**10.97**	**7.89**

DAP = Days after planting

Table 2. Petiole length (cm) of sweet potato at different stages of growth as influenced by different plant growth regulators

Sl. No.	Treatments	Petiole length (cm)			
		30 DAP	60 DAP	90 DAP	120 DAP
1.	T_{1-} GA_3 @ 25 ppm	12.67	19.62	25.19	27.42
2.	T_2- GA_3 @ 50 ppm	12.49	22.97	26.08	27.87
3.	T_3- GA_3 @ 100 ppm	13.23	26.83	29.86	31.99
4.	T_4- CCC @ 200 ppm	12.88	22.53	25.82	27.76

5.	T_5- CCC @ 250 ppm	13.11	20.85	25.26	27.49
6.	T_6- CCC @ 300 ppm	12.45	19.34	22.87	25.70
7.	T_7- IBA @ 100 ppm	14.12	20.09	24.00	25.79
8.	T_8- IBA @ 200 ppm	13.55	21.51	26.01	26.23
9.	T_9- Combination of GA_3 @ 50 ppm + IBA @ 200 ppm	12.26	23.41	26.92	28.24
10.	T_{10}- Combination of GA_3 @ 100 ppm + CCC @ 250 ppm	13.60	23.86	27.98	29.54
11.	T_{11}- Control	12.60	18.25	21.12	24.38
	S.Em±	**1.03**	**1.38**	**1.52**	**1.25**
	C. D. at 5%	**N.S**	**4.09**	**4.50**	**3.70**
	C.V.	**13.82**	**11.05**	**10.34**	**7.91**

DAP = Days after planting

Table 3. Leaf area (cm^2) of sweet potato at different stages of growth as influenced by different plant growth regulators

Sl. No.	**Treatments**	**Leaf area (cm^2)**			
		30 DAP	**60 DAP**	**90 DAP**	**120 DAP**
1.	T_1- GA_3 @ 25 ppm	47.90	64.15	75.03	83.32
2.	T_2- GA_3 @ 50 ppm	45.12	67.08	78.17	85.10
3.	T_3- GA_3 @ 100 ppm	52.73	73.50	85.18	93.60
4.	T_4- CCC @ 200 ppm	55.30	67.32	76.52	84.02
5.	T_5- CCC @ 250 ppm	47.51	65.88	74.25	83.18
6.	T_6- CCC @ 300 ppm	52.19	64.13	72.16	80.34
7.	T_7- IBA @ 100 ppm	48.17	65.49	72.53	80.26
8.	T_8- IBA @ 200 ppm	45.36	68.30	75.14	82.95
9.	T_9- Combination of GA_3 @ 50 ppm + IBA @ 200 ppm	52.14	71.15	81.72	90.55
10.	T_{10}- Combination of GA_3 @ 100 ppm + CCC @ 250 ppm	47.57	77.20	87.43	98.48
11.	T_{11}- Control	48.07	61.42	69.15	78.11
	S.Em±	**3.51**	**2.96**	**3.54**	**4.02**
	C. D. at 5%	**N.S**	**8.75**	**10.45**	**11.87**
	C. V	**12.35**	**7.58**	**7.97**	**8.15**

DAP: Days after planting

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RESEARCH ARTICLE

EFFECT OF NURSERY NUTRIENTS MANAGEMENT PRACTICES ON GROWTH AND YIELD OF SAMBHA MAHASURI RICE (*ORYZA SATAIVA L.*) UNDER FLOOD PRONE ECOSYSTEM

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Abstract: Present investigation was carried out to study the "Effect of nursery nutrients management practices on growth and yield of sambha mahasuri rice (*oryza sataiva* L.) under flood prone ecosystem" during wet season, 2013-14 and 2014-15. Experiment was laid out in randomized block design with three replication and one variety Sambha Mahsuri *sub1* in cemented pond (size; 21x17.50 m x1.25 m). Twenty five days old seedlings were transplanted in ponds. Recommended dose of nursery N, P, K& silicate @ 40:40:40 +120, 50 ppm Kg ha^{-1} was applied at 10 DAS. Main field accompined with nursery reframed with time schedule as ($T_3 N_2$) N 30 Kg ha^{-1} with combination of P and K @ 60, 50 Kg ha^{-1} applied as basal before transplanting followed by ($T_7 N_4$) N 30Kg ha^{-1} as top dressing at 5th day after de-submergence and P full dose before transplanting and K 20 kg ha^{-1} at 5th days de-submergence one week before flowering respectively (30Kg N ha^{-1} at each days), ($T_3 N_2$), N 30 Kg ha^{-1} with 40 Kg ha^{-1} P and K as basal application @ N 30 Kg ha^{-1} at 5th , 20th days after de-submergence and one week before flowering and with 40Kg ha^{-1} P and K as basal further recommended dose of N applied during post flood @ 60, 30 and N 30 Kg ha^{-1} at subsequently at 5th, 20th days after de-submergence and one week before flowering as foliar respectively. fifthteen (15) days complete submergence treatment was given after 20 days transplanting. Results indicated that before submergence lower dose of N @ (30 Kg ha^{-1}) and potassium (1/2) 25, 20 kg ha^{-1} at 5th days after de-submergence significantly increased the maximum plant survival ,plant height, dry weight, ear bearing shoot m^{-2} panicle length number of grain per panicle, test wt. in samba mahsuri *sub1* rice variety at par with $T_7 N_4$ in which N was applied in foure split doses (N 30 Kg ha^{-1}) as basal top dressing was higher in comparison $T_4 N_2$ $T_5 N_2$ $T_6 N_4$, $T_2 N_2$ and $T_1 N_1$ 5th days after de-submergence corresponded N 30 Kg ha^{-1} applied as basal at transplanting, mean while, plant mortality at recovery was higher (6.68 to 5.58%) in comparison to $T_7 N_4$ (6.32 to 5.92%). Although maximum plant mortality (6.68 to 5.58%) was recorded with N 30 Kg ha^{-1} applied as basal. Moreover, lower dose of N 30 Kg ha^{-1} applied with P and K @ 50, 40 Kg ha^{-1} as basal at transplanting and rest N applied in three split doses (30Kg ha^{-1} each split) with time frame *i.e.* bfore 5th days 20th days and booting and panicle emergence after de-submergence and one week before flowering significantly improved survival and yield (Kg/plot) of samba mahsuri *sub1* rice variety. Above package and practice might be recommended for farmer practice after further validation.

Keywords: Nursery nutrient management, Plant height, Dry biomass, Panicle length

INTRODUCTION

Rice (*Oryza sativa* L., 2n= 24), belongs to the family Poaceae. Rice is the most important food crop of the developing world and is the staple food of more than half of the world's population. It is especially important crop of Asia, where more than 90% of world rice is grown and consume. Rice farming is about 10,000 year old and largest single use of land for producing food. Rice fields covers 11% of Earth's entire arable land. Two rice species are important cereals for human nutrition *i.e. Oryza sativa* grown worldwide and *Oryza glaberrima* grown in parts of West Africa. Growth duration of rice crop ranging from 70 to 160 days exist in diverse environments. Flooding affects about 20 million ha in Asia each year and estimates indicate that submergence stress in rice causes corresponding annual losses of US$ 650 million to US$ 1 billion (Herdt, 1991; Dey and Upadhyaya, 1996). In India, about 16.1 million ha of rainfed lowland rice are grown each year, of which 4.4 million hacter are highly submergence-prone (intermediate rainfed lowlands; Haefele and Hijmans, 2007). In addition, submergence might also occur in shallow rainfed lowlands and irrigated lowlands. Recent research has identified the *SUB1* gene as the main gene controlling submergence tolerance in rice. The cloning of the gene underlying Rice in India was found area 37.48 million ha and production 88 million tons during 2014-15. Nutrient management in the nursery-submergence greatly affects N, P availability and assimilation, which can influence submergence responses and which have been implicated in difference tolerance between cultivars. Submergence rapidly depletes the protein reserves of the plants through hydrolysis to amino acids and other soluble N-containing compound. Useful nursery management options are particularly attractive to farmers since they need to apply them only on the small area occupied by the seed bed. Effective management strategies that can be applied

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at the nursery level include proper nutrient management, the use of organic manures, the use of a lower seeding density, proper water management, and transplanting of older seedlings when flooding is anticipated early after transplanting. Excess nutrient applications (especially N and Si) should be avoided because this results in vigorous growth and loss of stored carbohydrate reserves needed for survival during submergence. Higher soil fertility was also associated with enhanced shoot elongation and faster chlorophyll degradation during submergence (Ella and Ismail, 2006. Ella *et al*., 2011). Silicon (Si) is the second most abundant element both on the surface of the Earth's crust and in the soils. Although silicon has not been considered to be an essential element for higher plants, yet its beneficial effects have been demonstrated for many plants, especially when they are subjected to biotic or abiotic stresses (Ma and Yamaji, 2006; Sivanesan *et al*., 2011). Slag silicate fertilizer is applied to paddy fields in Japan to enhance rice Si uptake. However, the effect of slag silicate fertilizer on Si supplies in to soil solution various among different types of paddy soil. A part of the adsorbed Si in the soil solid phase can then be adsorbed and re-dissolved in to soil solution. However, the Si adsorption capacity differs between paddy soils and is associated with amount of active aluminum (Al), iron (Fe) and manganese (Mn), hydroxides, which function as Si absorbents the dissolution of Si from a SSF into aqueous solution decreases with increasing pH and calcium concentration in the solution. Therefore the effects of SSF on Si apply into the soil solution may vary with the chemical properties of the soil. Silicon is an important micronutrient for healthy and competitive growth of all cereals including rice in Asia (Bruing *et al.*, 2009).

MATERIALS AND METHODS

The present investigation was carried out in *Kharif* season, during 2013-2014 to 2014-2015 at the Instructional Farm, Department of Crop Physiology, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) India This site lies in the Gangetic alluvium of eastern UP, situated at latitude 26°47' North and longitude 82°12' East and at an altitude of 113 m above sea level. This is in a semi-arid zone receiving a mean annual rainfall of above 1,100 mm, of which about 80% is precipitated during the monsoon season (July to end of September) with the remainder falling mainly as showers in winter. The pooled nursery physicochemical soil test results of the experimental site in 2013-14 and 2014-15 were as follows: sand 35.20%, silt 48.60%, clay 16.20%, field capacity 39.60%, bulk density 1.3 g cm^{-2}, pH 7.6, EC 0.2 dSm^{-1}, organic carbon 0.3%, available N 57 ppm, available HAEFELE 7 ppm ($NaHCO_3$ pH 8.5) and available K 218 ppm. Nitrogen, phosphorus (P) and K content were estimated and calculated according to the methods given by Subbiah and Asiza (1956), Jackson (1969), and Olsen method.

Main field experiment (in side pond)

The 25-day old seedlings were transplanted into a newly constructed submergence pond covered with plastic sheets (size: 20x17x1.5 m^3) at NDUAT' Crop Physiology research field and were retained there until the end of experiment. FYM (cow dung) was applied at 6 t ha^{-1} one week before transplanting. N-P_2O_5-K_2O 120-40-40 kg ha^{-1} was applied in the side pond. The P and K was applied as a basal dressing whereas N was applied in three split doses: the first in the form of a top-dressing of N 40 kg ha^{-1} five days after de-submergence, and 20th days de-submergence the second and third top-dressings of N 20 kg ha^{-1} were made at 60 and 90 days after transplanting. The seedlings were transplanted at 20x15 cm spacing using single seedlings per hill before submergence and after de-submergence, while grain yields were recorded at maturity of all treatments on a per plot basis which was converted into t ha^{-1}. The samples were oven dried at 70 ^{0}C to obtain constant weight. All these observations were recorded on 10 initially tagged hills from each plot. Grains were harvested, dried, and weighed. Concentrations of N, P and K in the dried shoot material were determined in plants obtained before transplanting, before submergence and after de-submergence using methods described by Lindner (1944) and Jackson (1973). Nutrient uptakes were calculated as the product of concentration and biomass. Collected data were analyzed statistically following the method of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth and yield: Under normal condition application of nitrogen along with potassium and phosphorus provide mortality or strength to the plant. Application of nitrogen in nursery increases plant vigour in terms of plant height and dry matter accumulation. Maximum plant height before submergence (Table-1). Maximum plant height was recorded in treatment containing higher doses of N, P &K T_3 N_2 and T_7 N_4 in Sambha Mahsuri *Sub1 viz*, (42.38), (41.88) respectively. Maximum dry weight at before submergence table 2 existed in higher dose of nitrogen applied as a basal in respect to lower dose *i.e.*, (2.423, 2.446), (2.323, 1.664) respectively in Sambha Mahsuri *Sub1* rice variety. Survival (%) Data related to plant survival as affected by the different nursery nutrient management accompanied with main field nutrient management are presented in table3. 5th days after de-submergence was maximum survival percent was recorded in T_3 N_2 (98.79, 98.47) at par with T_7 N_4 (98.46, 98.46) followed by T_8 N_2 (98.44, 97.69) T_5 N_2 (98.08, 98.29), T_4 N_2 (96.89, 95.79) and minimum plant survival was obtained with T_1 N_1 (92.60, 94.23), T_2 N_2 (94.64, 94.32) and T_6

N_3 (94.62 , 97.45) and 20th days after de-submergence maximum $T_3 N_2$ (96.27, 96.94), at par with $T_7 N_4$ (95.68, 95.47) followed by $T_8 N_2$ (89.69, 85.49), $T_5 N_2$ (89.69, 91.85), $T_4 N_2$ (90.58, 87.30) and minimum plant survival was obtained with $T_1 N_1$ (77.83, 78.25) ,$T_2 N_2$ (84.50, 94.27) and $T_6 N_3$ (84.30, 82.30) respectively Chaturvedi *et al.,* (1995), similarly in contrast Voesenek *et al.,* (2006) reported that rapid shoot elongation increases carbohydrate consumption which resulting less survival percentage after flooding and Ella and Ismail (2006) also suggested that plant enrichment with nitrogen before submergence adversely affected survival after submergence reported that old seedling tend to have large carbohydrate reserves, therefore good survival during submergence. Unlike deep water and other aquatic plants, the importance of slow growth in rainfed lowland rice during submergence has been suggested to be beneficial in that it prevents damage due to lodging once water recedes following a flash flood. Similar result also found by (Singh, 2001; Jackson and Ram, 2003). Srivastava, (2007) Winkel *et al.* (2013) and Winkel *et al.,* (2014) reported that rice leaves have gas films that aid O_2 and CO_2 exchange and that underwater photosynthesis can take place supported by high irradiance at depth during submergence, resulting in biomass production after de-submergence It seems that high nitrogen in combination with phosphorus and potassium helpful in shoot growth. (Mahyer Gerami *et al.,* 2012) reported that where silicate applied in the source of silicon in stem and leaf tissues were increases .had a positive effect on morphological characters thus further study N_2 (N_{40}:P_{40}:K_{40} kg ha^{-1}) treated seedling were used for main field. experiment which comprises eight treatments to assess the response of different level of N, P and K for and silicate applied before and after de-submergence on rice plants periodically submerged at 60 days crop growth stage for 15 days with clear water. A. AHMAD *et al.,* (2013) A field experiment was conducted at University of Agriculture, Faisalabad, Pakistan, to investigate the of foliar application of silicon on yield and quality of fine rice (*Oryza sativa* L.). The research was designed as randomized complete block design (RCBD) having three replications and 6m x 4.5 m net plot size was maintained. Foliar applications of silicon's aqueous solution were used as treatments comprised of control, 0.25%, 0.50%, 1.00% silicon solutions. Nursery of 30 days old seedling nursery was transplanted to the plots under aerobic condition and 22.5 cm hill to hill distance was maintained. Sodium silicate (20.35% Si) as the source of silicon (soluble in warm water) was used. Fertilizer inputs as nitrogen, phosphorus and potassium were uniformly applied at the rate of 100, 67, 67 kg ha^{-1} while all other agronomic practices were kept constant for all the treatments. The data from the field (yield components) as well as lab analysis (quality parameters) was recorded according to the standard procedures. Fisher's analysis of the variance technique was used for statistical analysis and treatment's mean differences were compared using least significant difference (LSD) test at 5% probability level. It was observed that plant crop stand, plant height , Ear bearing shoot m^{-2}, panicle length, number of grains $panicle^{-1}$, test weight, total seed number $panicle^{-1}$, fertile grains $panicle^{-1}$, sterile grain $panicle^{-1}$, sterility %, biological yield, grain yield, straw yield and harvest index significantly enhance with enrichment of seedling nutrient and survival. Yield and yield contributing characters significantly influenced by irrespective doses and integrated nutrient management in nursery and N, P &K application just after de-submergence (5th day after submergence. Maximum plant height table 4 at maturity T_3 N_2 (83.00, 94.38) ear bearing shoot m^{-2} was observed with $T_3 N_2$ (488.30, 487.33) whereas, maximum panicle length and number grain panicle-^{1} was observed in $T_3 N_2$ (21.66, 23.04),(215.33, 215) followed by T_7 N_4, $T_4 N_2$, $T_5 N_2$, $T_6 N_3$, $T_8 N_2$ and T_2 N_2, shows superiority over other treatments. It is also reflected from maximum test weight observed maximum in higher doses of N,P &K (N_{120}:P_{60}:K_{50}) T_3 N_2 (22.43, 22.30), T_7 N_4 (N_{120}:P_{60}:K_{40}) (21.56, 21.83) followed by $T_4 N_2$, $T_5 N_2$, $T_6 N_3$, $T_8 N_2$ etc. Since, that phosphorus and potassium both helpful in re-establishment of plant and maintain the plant growth during submergence than nitrogen. (Singh *et al.,* 2006). Mustafa *et al.,* (2011) application of N, P and K significantly affected total number of tillers, number of panicle, and number of grain per panicle. Silicon showed no significant effect on plant height harvest index, number of kernels and opaque kernels percentage. Silicon (0.50% silicon solution) produced maximum grain diameter and grain protein while silicon @ 1.00% silicon solution resulted maximum in number of productive tillers, straw yield, spike per panicle, 1000 grain weight, paddy yield and grain starch. All others parameters have overlapping results of different silicon level.

Table 1. Effect of various fertilizer combinations in main field on plant height (cm) of Sambha mahsuri *Sub1* under flood prone ecosystem completely submerged for 15 days.

Treatments	Before submergence		After de-submergence (5th days)		After de-submergence (20thdays)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
T_1N_1	38.10	35	68.16	68.16	55.16	55.68

T_2N_2	39.27 (3.07)	36.33 (3.80)	70.33 (3.10)	70.33 (3.18)	62.23 (12.81)	61.66 (10.73)
T_3N_2	42.38 (11.23)	46 (31.4)	80.43 (18.00)	80.43 (18.00)	73.56 (33.35)	73.83 (32.59)
T_4N_2	41.63 (9.26)	36 (2.85)	72.10 (5.74)	72.10 (3.94)	63.33 (14.81)	63.5 (14.04)
T_5N_2	40.38 (5.98)	37.16 (6.17)	68.66 (0.73)	68.66 (0.73)	60.16 (9.06)	60.33 (8.35)
T_6N_3	40.33 (5.85)	36.66 (4.70)	69.26 (1.60)	69.26 (1.61)	58.16 (5.43)	59.00 (5.96)
T_7N_4	41.88 (9.92)	37.66 (7.60)	72.16 (5.80)	72.16 (5.8)	69.33 (25.68)	69.33 (24.51)
T_8N_2	38.29 (0.49)	35.88 (2.51)	70.16 (2.90)	70.16 (2.93)	59.83 (8.46)	60 (7.75)
SEm ±	3.81	0.65	0.45	0.45	1.69	1.41
CD at 5%	1.26	0.21	0.15	0.15	0.56	0.46

*Parenthesis indicate percent increase/decrease

Table 2. Effect of various fertilizer combinations in main field on plant dry weight (mg plant^{-1}) of Sambha mahsuri *Sub1* under flood prone ecosystem.

Treatments	**Before submergence**		**After de-submergence (5th days)**		**After de-submergence (20th days)**	
	2013-14	**2014-15**	**2013-14**	**2014-15**	**2013-14**	**2014-15**
T_1N_1	0.876	1.173	0.794	0.795	1.085	1.087
T_2N_2	0.969 (10.61)	1.470 (25.20)	0.994 (25.18)	1.981 (149.18)	1.620 (49.30)	1.612 (52.50)
T_3N_2	2.423 (176.50)	2.446 (108.50)	2.774 (249.00)	2.166 (172.45)	2.361 (117.60)	2.363 (117.00)
T_4N_2	2.053 (134.30)	1.448 (23.40)	1.785 (124.00)	1.780 (123.83)	2.003 (91.80)	1.818 (67.24)
T_5N_2	1.247 (42.30)	1.365 (16.30)	0.866 (9.06)	0.870 (9.43)	1.863 (71.70)	2.006 (84.50)
T_6N_3	2.049 (133.90)	1.243 (5.90)	0.908 (14.35)	0.900 (13.20)	1.206 (11.15)	1.208 (11.13)
T_7N_4	2.323 (165.10)	1.664 (41.80)	2.124 (167.00)	1.870 (135.00)	2.063 (90.10)	2.066 (90.00)
T_8N_2	1.628 (85.80)	1.630 (38.90)	0.986 (24.18)	0.990 (24.52)	1.940 (78.80)	1.942 (78.61)
SEm ±	0.01	0.03	0.20	0.10	0.00	0.01
CD at 5%	0.00	0.01	0.06	0.03	0.00	0.00

*Parenthesis indicate percent increase/decrease

Table 3. Effect of various fertilizer combinations in main field on plant survival (%) of Sambha mahsuri *Sub1* under flood prone ecosystem.

Treatments	**Survival (%)**			
	After de-submergence (5th days)		**After de-submergence (5th days)**	
	2013-14	**2014-15**	**2013-14**	**2014-15**
T_1N_1	92.60	93.02	77.83	78.25
T_2N_2	94.64 (2.20)	94.32 (1.39)	84.5 (8.50)	94.27 (20.47)
T_3N_2	98.79 (6.68)	98.47 (5.85)	96.27 (30.40)	96.94 (23.88)
T_4N_2	96.89 (4.63)	95.79 (2.97)	90.58 (16.30)	87.30 (11.56)
T_5N_2	98.08 (5.91)	98.29 (5.66)	91.76 (17.80)	91.85 (17.83)

T_6N_3	94.62 (2.18)	97.45 (4.76)	84.30 (8.30)	82.3 (5.17)
T_7N_4	98.46 (6.32)	98.46 (5.92)	95.68 (22.90)	95.47 (22.00)
T_8N_2	98.44 (6.28)	97.69 (5.02)	89.69 (15.20)	85.49 (9.25)
SEm ±	0.03	1.68	6.38	0.03
CD at 5%	0.01	0.55	2.10	0.01

*Parenthesis indicate percent increase/decrease

Table 4. Effect of various fertilizer combinations in main field on ear bearing shoot (m^{-2}), panicle length, no. of grains panicle^{-1} and test wt. of rice plants

Treatments	**Ear bearing shoot (m^{-2})**		**Panicle length (cm)**		**No. of grains panicle^{-1}**		**Test weight (g)**	
	2013-14	**2014-15**	**2013-14**	**2014-15**	**2013-14**	**2014-15**	**2013-14**	**2014-15**
T_1N_1	323.3	325.33	19.50	21.28	117.33	119.00	19.33	**18.83**
T_2N_2	394.0 (21.8)	393.33 (20.90)	20.66 (5.90)	21.50 (1.00)	176.66 (50.56)	177.67 (49.30)	20.63 (34.70)	20.30 (8.01)
T_3N_2	488.3 (31.7)	487.33 (49.70)	21.66 (11.07)	23.04 (8.20)	215.33 (83.52)	215.00 (80.60)	22.43 (16.00)	22.30 (18.43)
T_4N_2	383.6 (3.50)	382.66 (17.60)	20.66 (5.90)	22.16 (4.10)	167.67 (42.90)	168.33 (41.45)	20.83 (7.75)	20.60 (9.39)
T_5N_2	418.3 (29.30)	419.33 (28.80)	20.00 (2.56)	21.33 (0.23)	147.33 (25.00)	148.33 (24.60)	21.22 (9.70)	21.29 (12.70)
T_6N_3	383.3 (3.42)	385.33 (18.40)	19.83 (1.60)	21.27 (0.21)	137.33 (17.00)	138.33 (16.24)	22.09 (10.50)	20.90 (10.90)
T_7N_4	432 (12.70)	433.33 (33.10)	21.16 (8.51)	21.43 (0.70)	186.33 (58.80)	189.00 (58.80)	21.56 (9.90)	21.83 (15.90)
T_8N_2	370.6 (3.30)	421 (29.40)	19.83 (1.60)	21.42 (0.68)	183.33 (56.20)	184.00 (54.60)	20.9 (7.80)	22.09 (17.30)
SEm ±	16.95	37.1	1.06	0.54	2.16	1.35	0.64	1.09

*Parenthesis indicate percent increase/decrease

CONCLUSION

The results of the experiment indicated that N, P, K 40:40:40 kg ha^{-1} alone or supplied together with silicate fertilizer produced significantly higher root length, root number, root dry wt., root CHO and biochemical activities there after helped in rapid regeneration, which was reflected in the form of higher yield. Proper nursery nutrient management using K can contribute considerably to maximizing submergence tolerance and grain yield of the rice crop in the field. A slightly higher dose of P along with the normal K dose also produced a higher yield than the normal P dose used in nursery management. These results, however, need further validation on farmers' fields applying lower N doses with K and P.

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RESEARCH ARTICLE

PROSPECTIVE OF SELECTED GREEN ALGAE PERTAIN TO BIOFUEL PRODUCTION

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Abstract: Fossil fuels are the main source of energy for transportation and industrialization. Growing population creates a huge demand of fossil fuels which become cause of exhaustion in near future. Burning of fossil fuels is also cause of climate change, global warming, pollution and various health issues in living organism, so fossil fuels become a topic of concerns for scientist and environmentalist. Petroleum based fuels can be substituted by the biofuels, which can be obtained by the trans-esterification algal oil. Algae are the most efficient producer of oil owing to its higher proficiency of CO_2 fixation, cost-effectiveness and insignificant cultivation land. This study was done to know the potential and physicochemical properties of different algal species found in local water bodies.

Keywords: Algal oil, Chemical extraction, Biodiesel, Biofuel, Transesterification, Renewable energy

INTRODUCTION

Petroleum based fuels are limited in nature and major energy crises in near futureenforced to find alternative sources of energy. Algae provide a beneficial prospective for biofuel, waste water treatment and mitigation of Greenhouse Gas (GHG). Algae are more efficient in bio-fixation of CO_2 than the terrestrial plants. The price of crude petroleum reached 145 $ US/barrel in July 2008 the highest price ever achieved in 30 years. The average price of crude oil was 51 $ US/ barrel in 2015.The demand for energy is growing worldwide especially in many of the rapidly developing countries such as in China and India. Deficit fossil fuels influence the growth of developing country so we have to look forward for the alternate source of energy. Furthermore, the continued combustion of fossil fuels has created serious environmental concerns, burning of fossils fuels are cause of various respiratory diseases like Asthma, irritation in eyes and nose and skin inflammation of human. The rapid increase in combustion of fossil fuels becomes a cause of climate change and global warmingso this is mandatory to sequester atmospheric CO2 and find out technique to reduce CO2 emission to the atmosphere. Algae are not only feedstock of biofuel but it helps in mitigation of GHG.

The ethanol and biodiesel are the two liquid of biofuels that can replace gasoline and diesel respectively (Dwivedi et. al. 2013). Now a day, biodiesel is produced from various crops such as Jatropha, Karanja, Sunflower, Palm, Coconut, Soybean, Animal fat and Rapeseed, but these crops have food demand, require more space to cultivate and a lot of money to process. Among the various biomass sources, microalgae are the most successful and suitable for biofuel production. The algae are the autotrophic thalophytes; they can fix CO2 from the environment efficiently in the form of lipid (Maltsev et. al. 2017) and other organic substances by the process of photosynthesis. Algal cultivation does not require fertile soil so with the production of biofuel soil management is also possible. The ex-President India, Late Dr. Abdul Kalam said that out of the 600,000 km² of wasteland that is available in India over 300,000 km² are suitable for Jatropha cultivation, While other 300,000 km² can be used for the algal cultivation.

In 1942 Harder and Von Witsch were the first to propose that microalgae be grown as a source of lipids for food or fuel. The use of microalgae can be a suitable alternative because of higher photosynthetic efficiency, higher biomass production highest CO2 fixation, O2 production and a faster growth rate than plants. Algae grow much faster than food crops, and can produce hundreds of times more oil per unit area than conventional crops Rapeseed, Palms, Soybeans, or Jatropha. Algae can also grow on the surface of the ocean in bags or floating screens. Algae are the most efficient producer of oil on the planet and a versatile biomass source and may soon be one of the earth's most important renewable fuel crops. (Campbell, CJ, et al. 1997). However, fossil fuels and biofuels both are the hydrocarbon and release CO2 after combustion but the released CO2 by the combustion of biofuels were already fixed through photosynthesis so ultimately CO2 do not increase in environment, while combustion of fossil fuels increase the level of carbon dioxide, nitrogen oxides, methane, sulfur dioxide and volatile organic compounds in environment. (Gavrilescu and Chisti, 2005) Studies have determined that replacing fossil fuels with renewable energy sources, such as biofuels, have the capability of reducing CO2 emissions by up to 80%. Furthermore, compared to fuels like diesel and petroleum, and even compared to other sources of biofuels, the production and

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combustion of algal biofuel does not produce any sulphur oxides or nitrous oxides, and produces a reduced amount of carbon monoxide, unburned hydrocarbons, and reduced emission of other harmful pollutants. (Hemaswarya et. al. 2012)

Local water bodies contain a diverse group of aquatic species of algae which can be used as source of oil. Pithophora is the example of macro algae which is a eukaryotic free floating filamentous alga, which can easily grow in different water bodies. They efficiently fix CO2 in form of lipid and other organic substances, and store in cells. Lipid can be extracted by various physical and chemical mean, after that extracted lipid can be converted in biodiesel through the process of transesterification. Transesterification is a process of conversion of triglycerides in to fatty acid methyl ester (FAME/biodiesel). Transesterification reaction can be catalyzed by both homogeneous (alkalis and acids) and heterogeneous catalysts. Biodiesel is mono-alkyl ester made from natural and renewable vegetable oil and animal fats based feedstock. The biodiesel is similar in fuel characteristics to conventional diesel. Biodiesel is compatible with petroleum diesel and can be blended in any proportion with diesel to create suitable biodiesel blend. In addition, Pithophora takes more time to oxidize and best suited for biodiesel production while the other oil needs antioxidant to increase their stability for biodiesel production. (Kumar and Sharma et. al. 2013)

The purposes of current study comprise collection of those algae which are copiously occurred in water bodies of Agra, extractionof lipidsvia chemical extraction method,to find out efficient alga from *Pithophora*and*Chlorococcum* and trans-esterification of lipid.

MATERIALS AND METHODS

Collection and processing of raw material

Macro and micro-algae samples have been collected from the water bodies of Agra, India. After microscopic observations two *Pithophora* and *Chlorococcum*were found significantly. *Pithophora* washed thoroughly with tap waterand stay under sunlight for three days to dry. After drying *Chlorococcum* found in the form of flakes and *Pithophora* as wool. Both were grinded separately by electric grinder to powder it. If water molecules present in processed material, it prevents the dissolution and extraction of lipid in the non-polar solvent so kept in oven at 80°C for 2hours for the complete dehydration.

Lipid extraction process (chemical method)

Oil extraction is done by Soxhlet extraction method. 100 g. of both algal powders weighed and kept in extraction tube. 500 ml of petroleum ether measures as a solvent for each sample and placed in to the flask. Condenser tube placed on the extraction tube and water supply provided properly, and heat source ran till the complete extraction of lipid.

Extracted oil in solvent separated by the evaporation of solvent. I have been developed a very primitive improvised apparatus with glassware's of lab for the recovery of solvent. Solvent evaporation and recovery took less than 30 minutes; lipid still contained a little amount of solvent so kept in open air over night for the complete evaporation of solvent. Obtained lipid content is weighted.

Lipid purification and testing

Extracted lipid contained cell debris and other unwanted solid material which can cause errors in result so are they removed by centrifugation at 3000 rpm for 5 minutes. After centrifugation lipid and cell debris were weighted and kept in air tight container.

There are various easy and cheap methods are developed for lipid testing, some of them are Sudan regent which soluble with lipid and give red color appearance. Lipid dissolves in methanol and makes a homogenous suspension. Red color with Sudan reagent and complete dissolution of lipid with methanol confirmed the presence of lipid.

Production of biodiesel

Preparation of catalyst: Transesterification is a catalytic process. 20 ml of methanol measured and 0.20 gram of sodium hydroxide (NaoH) weighted put in conical immediately covered, stirred the mixture properly for 20 minutes.

Transesterification: For the completion of transesterification prepared catalyst poured in to 100 ml of lipid in the 250 ml of conical flask and put the conical flask on the electric shaker for 3 hours at 300 rpm. Algal oil is triglycerides molecules. In the presence of methanol and sodium hydroxide triglycerides converted in to fatty acid methyl ester (FAME)/ biodiesel and glycerol.

Washing: Transesterified lipid kept overnight to the settling of glycerol and pigments. Glycerol and pigments are separated carefully with the help of dropper. Biodiesel put in flask for washing and measured 5 ml of distilled water. Now water is poured in to the biodiesel containing flask and shaken well. Water soluble contamination dissolves in water. And water was separated by the dropper. Biodiesel kept under running fan for 12 hours. Finally biodiesel measured by the measuring cylinder and kept in air tight container and stored for analysis.

RESULTS AND DISCUSSION

The aim of this study is to find out the potentiality of algae in production of biofuel collected from local water bodies. The targeted algae were *Pithophora* and *Chlorococcum* However; lipid extraction was done in the same solvent with same apparatus and method for both algae. But they were significantly different to each other.

Table 1. Required time to complete extraction of lipid by Soxhlet apparatus

S.No.	Treatment	Solvent	Extraction Time
1.	*Pithophora species*	Petroleum ether	48 hours
2.	*Chlorococcum species*	Petroleum ether	56 hours

Pithophora took less time in total extraction of lipid and *Pithophora* also contains relatively less amount of lipid while *Chlorococcum* took much time, it supposed to be lipid content is directly proportional to the extraction time, because more lipids takes more time to dissolve in solvent.

Table 2. Extracted lipid from different algae

Treatment	Dry weight	Extracted oil (ml)	Extracted oil (g)	Percentage of oil
Pithophora species	100gm	7.5	6.38	6.3%
Chlorococcum species	100gm	24.7	20.40	20.4%

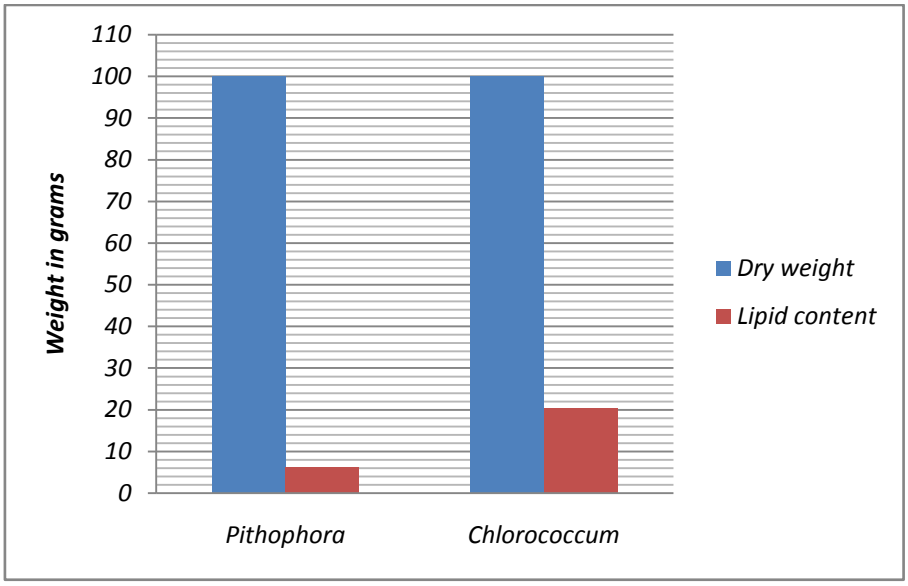

Fig.1: Lipid content in *Pithophora* and *Chlorococcum*

For the lipid extraction dry weight of *Pithophora* and *Chlorococcum* was the same but the lipid found significantly high in *Chlorococcum* than the *Pithophora*. A.B.M. Sharif Hossainet. al. (2008) reported that *Spirogyra* contained 7.3 % of lipid and *Oedogonium* contained 9.2% of lipid while *Pithophora* contained only 6.3% of lipid which is relatively low, while *Chlorococcum* produces relatively much higher lipid among them and it is a microalga.

Density of lipid

Formula $D = \frac{M}{V}$ where, **D** is the density of lipid, **M** is mass of lipid, and **V** is the Volume of lipid**.**

Density of lipid of Pithophora $D = \frac{M}{V}$, $D = \frac{6.38}{7.5} = 0.850 g/_{cm}3$

Density of lipid of Chlorococcum $D = \frac{M}{V}$, $D \frac{4.132}{5} = 0.826 \ g/_{cm}3$

Lipid of *Pithophora* is relatively denser than the lipid of *Chlorococcum.* Density of lipid is $0.850 g/_{cm}3$and 0.826 $g/_{cm}3$ in *Pithophora* and *Chlorococcum* respectively. Density of all algal oils approximately matches the density ranges of a biofuels given by EN 14214 and ISO 15607 (0.86-0.90 $g/_{cm}3$)thus our results are compatible with these standards (*Pathak et. al., 2015)*

Table 3. Biodiesel extracted from different algae

S.No.	Treatment	Biodiesel (ml)
1.	***Pithophora species***	7.6
2.	***Chlorococcum species***	27.5

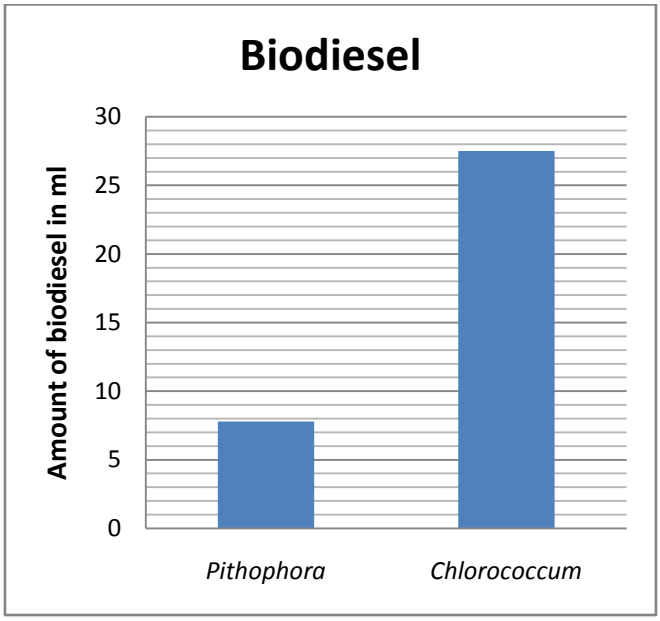

Fig.2: Biodiesel production in *Pithophora* and *Chlorococcum*

(a) (b) (c) (d)

Fig.3: (a) Extracted lipid (b) residual biomass after lipid extraction (c) cell debris after lipid purification (d) biodiesel.

CONCLUSION

Now a days demand of fuels increasing day by day as population increasing and burning of fossil fuels create serious health issues and environmental hazards, so we have to look for the sustainable use fuels and we left with ecofriendly fuels which are biofuels and Algae are the efficient producer of lipid which can be used as source of biofuel. Results proved that microalgae as well as macroalgae both can be used as ecofriendly and renewable energy. Although, *Pithophora* and *Chlorococcum* both produces lipid but there is huge difference in amount of lipid content. Results showed that *Chlorococcum* produce approximately 4 times more biodiesel than the Pithophora. So it is concluded that microalga is the efficient producer of lipid than the macroalga. And it is strongly recommend that further researches should be done in this field, becauseit will decrease the dependency on the fossil fuels. Algal biofuel will also provide economic fuel, secure future and a pollution free environment.

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RESEARCH ARTICLE

RESPONSE OF ZINC ON GROWTH AND BIOCHEMICAL CHANGES OF WHEAT (*TRITICUM AESTIVUM* L.) UNDER SODIC SOIL

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Abstract: The present investigation was carried out under field condition at main experiment station (MES) of Narendra Deva University of agriculture & Technology, Narendra Nagar, Kumarganj, Faizabad U.P. during Rabi season 2010-11. The experiment was executed in completely randomized block design (factorial) with three replications. Six treatments comprised of zinc application *i.e.* (control 1%, 1.5% $ZnSO_4$ seed soaking, 15 kg and 25 kg $ZnSO_4$ ha^{-1} basal application and 1% $ZnSO_4$ +2.5% urea foliar spray and three wheat verities (Raj-3077, NW-1014, UP-2425). Seed soaking, basal application and foliar spray of $ZnSO_4$ increased growth characters in all varieties of wheat. Wheat variety UP-2425 responded better in comparison to NW-1014 and Raj-3077. Variety UP-2425 performed maximum plant height number of tiller, Leaf area, dry weight $plant^{-1}$ as compared to Raj-3077 and NW-1014 at the crop growth stages. A control sets was also maintained. Seed soaking, basal application and foliar spray of $ZnSO_4$ increased growth characters and biochemical changes in all varieties of wheat. Application of 25kg $ZnSo_4ha^{-1}$ in soil significantly increased in chlorophyll content, carbohydrate content obtained. Wheat variety UP-2425 responded better in comparison to NW-1014 and Raj-3077. It is concluded from the results that basal application of 25 kg $ZnSo_4$ ha^{-1} was found superior and economical in comparison to other treatments.

Keywords: Zinc, Foliar application, Growth, Soluble carbohydrate, Chlorophyll

INTRODUCTION

Wheat (*Triticum aestivum* L.) a crop of poaceae family which is a major staple food crop of the world after rice. It is primarily grown in temperate region at higher altitude and medium altitude of tropical climate. However, it is cultivated widely around the world due to wide adoption and greater role in human nutrition as well as agricultural economy. With shrinking of arable land due to urbanization and industrialization, the wheat cultivation is also being pushed to marginal lands including salt affected soils. Sodic soil are widespread in the world and in India it occurs mainly in Indo-Gangetic alluvial plains, where it is estimated to cover about 2.8mha in India, salt affected soils are spread 7.0mha of which 1.29mha. exists in U.P. alone (Abrol and Bhumbla 1971). However information of salts affected area in India indicates for 13.0mha. (Yadav and Gupta 1984).Salt affected soil contain excessive concentration of chloride and sulphate of sodium, calcium and magnesium (saline soil) or and excess of exchangeable sodium (alkaline or sodic soil) along with carbonate and bicarbonates. Excessive exchangeable sodium, high pH and poor physical properties of soils are known to adversely affect the growth, yield, chemical composition and nutrients uptake of plant. The adverse effect of soil sodicity is also mediated through the unavailability of certain micronutrients like zinc and iron. The available zinc in Indian soil ranges between 0.08-20.5ppm, Application of zinc have been found to boost the growth and yield of crops to a great extent (Zaid et al. 1977) Zinc deficiency includes rooting and poor tillring leading to decreased productivity in crop plants, since zinc is co-factor of carbonic anahydrase and aldase there fore it may adversely affect enzyme activities and carries corresponding metabolic reaction when zinc is deficient in soil. Zinc is also involved in synthesis of protein tryptophan (amino acid), superoxide dismutase (SOD) activity is much lower but can be restored in vitro by resupplying zinc to the assay medium (Vaugh an et al. 1982).

MATERIALS AND METHODS

The present study was conducted to investigate the response of wheat genotypes Raj-3077, NW-1014, UP-2425, to different treatmentT_{1-} Control,T_{2-} Seed soaking- .0% ZnSo4 (Soaking for 4 hours and drying in shade for 24 hours before sowing). T_{3-} Seed soaking-1.5% ZnSo4 (Soaking 4 hours and drying in shade for 24 hours before sowing). T_{4--}ZnSo4-15 Kg/ha basal application. T_{5-} ZnSo4-25 Kg/ha basal application. T_{6-} Foliar Spray at tillring and booting stage-1.0%ZnSo4+2.5%Urea.Wheat genotypes was collected from seed resource centre of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). Seed soaking with respectively $ZnSo_4$ solution was done for four hours and then soaked seed were dried in shade for 24-

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hours before sowing. Treated seeds of wheat varieties viz NW-1014, Roj -3077, UP-2425 were sown on 14.12.2012 in rows, spacing 22 cm. at depth of 5.cm as soon as possible planked immediately after sowing. Frequent and light irrigation was given to each plot as and when required. The frequency of irrigation was higher during March and April months. Growth observations were recorded at 30, 60 and 90 DAS stages of crop. Plant height (cm) of five plants was measured from the base of stem up to the apex of the plants; the average height was calculated over three replications. No. of tillers per plant under each treatments were recorded by counting at 30, 60 and 90 DAS. The leaf area (cm) ^{2} was measured by automatic leaf area meter (LICOR-USA model L1-3000). Plant material was oven dried at 70 $^{\pm\ 0}$C separately and their dry weight was added to obtain total biomass of plant. Chlorophyll content was estimated according to the method of Arnon (1949) and expressed as mg g-1 fresh weight of leaves. Total soluble carbohydrate was measured by the method of Yemm and Willis (1954). The statistical analysis of experimental data was done by method described by Fisher method of analysis of variance (Fisher and Yates, 1949) randomized block design.

Table 1. Effect of zinc application on plant height (cm) at various growth stages of wheat varieties under sodic soil.

Varieties / Treatment	30 DAS				60 DAS				90 DAS			
	RAJ-3077	NW-1014	UP-2425	MEAN	RAJ-3077	NW-1014	UP-2425	MEAN	RAJ-3077	NW-1014	UP-2425	MEAN
T_1	15.66	17.45	16.33	16.48	48.21	54.71	53.90	52.27	56.55	61.10	59.70	59.12
T_2	19.33	20.33	20.00	19.89	51.33	59.41	61.60	57.46	4.88	66.90	65.33	64.37
T_3	22.33	23.50	22.15	22.66	53.10	6032	61.10	58.17	64.10	68.35	66.10	66.18
T_4	22.0	24.10	23.10	23.07	54.10	61.50	61.44	59.01	66.77	70.0	69.40	68.72
T_5	24.33	26.56	25.66	25.52	56.44	63.64	62.97	61.02	69.50	73.15	71.0	71.22
T_6	22.24	24.78	24.31	23.78	55.72	60.33	60.10	58.72	66.90	71.30	69.78	69.33
Mean	20.98	22.79	21.93	21.90	53.15	59.94	60.19	57.78	64.12	68.47	66.89	66.49
SEM±	0.566	04.00	0.980		1.316	0.930	2.279		1.681	1.188	2.911	
CD at 5 %	Zn = 1.625, V =1.15 Zn × V= NS				Zn=3.78, V=2.67, Zn x V =NS				Zn = 483,V=3.415,Zn x V=NS			

Table 2. Effect of zinc application on number of tillers plant^{-1} at various growth stages of wheat varieties under sodic soil.

Varieties / Treatment	30 DAS				60 DAS				90 DAS			
	RAJ-3077	NW-1014	UP-2425	MEAN	RAJ-3077	NW-1014	UP-2425	MEAN	RAJ-3077	NW-1014	UP-2425	MEAN
T_1	3.90	3.40	3.00	3.43	7.50	6.50	6.20	6.73	7.40	6.20	6.0	6.53
T_2	4.20	3.70	3.30	3.73	7.80	7.0	7.50	7.43	7.50	6.90	7.40	7.27
T_3	4.50	3.90	3.30	3.90	8.10	7.40	7.60	7.70	7.90	7.0	7.40	7.43
T_4	4.90	4.20	4.50	4.20	8.30	7.90	7.90	8.30	8.0	7.60	7.6	7.73
T_5	5.40	4.50	3.10	4.67	9.0	8.30	8.0	9.0	8.30	8.0	7.90	8.07
T_6	4.70	3.70	3.60	4.00	8.50	8.00	7.50	8.50	7.80	7.70	7.0	7.50
Mean	4.60	3.90	3.47.	3.99	7.52	7.52	7.45	7.72	7.23	7.23	7.22	7.42
SEM±	0.096	0.068	0.166		0.182	0.129	0.315		0.170	0.120	0.294	
CD at 5 %	Zn = 0.276, V=0.195, V x Zn =NS				Zn = 0.5, V= 0.369, V x Zn =NS				Zn=0.48, V=NS, V x Zn =NS			

Table 3. Effect of zinc application on leaf area plant $^{-1}$ (cm^2) at various growth stages of wheat varieties under sodic soil.

Varieties / Treatment	30 DAS				60 DAS				90 DAS			
	RAJ-3077	NW-1014	UP-2425	MEAN	RAJ-3077	NW-1014	UP-2425	MEAN	RAJ-3077	NW-1014	UP-2425	MEAN
T_1	159.5.	161.10	170.53	163.71	175.35	180.92	182.60	179.62	181.45	183.95	185.77	183.72
T_2	172.53	175.30	179.51	175.78	191.76	192.92	195.45	193.37	193.20	194.75	197.45	195.13
T_3	177.86	178.40	184.32	180.19	195.25	194.56	197.83	195.88	195.90	197.10	199.80	197.60
T_4	180.96	182.43	187.32	183.70	198.78	202.70	205.10	202.19	199.10	201.80	202.45	201.22
T_5	185.33	187.63	191.85	188.34	190.00	205.95	209.87	235.27	205.78	207.60	208.30	207.22

T_6	179.60	184.35	186.18	183.34	196.85	203.43	206.77	202.35	205.10	204.35	203.75	203.40
Mean	176.0	178.20	183.35	179.18	208.00	196.74	199.60	201.45	196.26	198.26	199.64	198.05
SEM±	4.20	2.973	7.281		4.44	3.142	7.697		4.894	3.461	8.477	
CD at 5 %	Zn = 12.08, V = NS, V x Zn=NS				Zn=12.77, V=NS, V x Zn=22.12				Zn=14.06, V=0.345, V x Zn=NS			

Table 4. Effect of Zinc application on dry matter plant^{-1} (g) at various growth stages of wheat varieties under sodic soil.

Varieties	**30 DAS**				**60 DAS**				**90 DAS**			
Treatment	**RAJ-3077**	**NW-1014**	**UP-2425**	**MEAN**	**RAJ-3077**	**NW-1014**	**UP-2425**	**MEAN**	**RAJ-3077**	**NW-1014**	**UP-2425**	**MEAN**
T_1	2.05	2.10	2.46	2.20	3.50	4.15	4.43	4.03	7.28	7.65	8.33	7.75
T_2	2.80	2.81	3.10	2.90	4.60	4.94	4.97	4.66	8.28	8.64	8.78	8.55
T_3	2.86	2.95	3.26	3.02	4.65	5.03	5.03	4.89	8.65	8.75	8.95	8.78
T_4	3.00	3.23	3.40	3.21	5.10	5.35	5.51	5.12	8.97	9.15	9.34	9.15
T_5	3.20	3.45	3.75	3.47	4.78	5.74	5.83	5.56	9.03	9.43	11.16	9.87
T_6	2.90	2.86	3.24	3.00	4.78	5.24	5.26	5.09	8.90	9.17	9.45	9.17
Mean	2.80	2.90	3.20	2.97	4.39	5.08	5.23	4.90	8.51	8.80	9.34	8.88
SEM±	0.069	0.49	0.119		0.136	0.0096	0.236		0.205	0.145	0.356	
CD at 5 %	Zn= 0.198, V=0.14, V x Zn = NS				Zn= 0.392, V= 0.277, V x Zn =NS				Zn=0.59, V= 0.418, V x Zn= NS			

Table 5. Effect of zinc application on total chlorophyll content in leaf (mg/g fresh wt.) at various growth of wheat varieties under sodic soil.

Varieties	**30 DAS**				**60 DAS**				**90 DAS**			
Treatment	**RAJ-3077**	**NW- 1014**	**UP-2425**	**MEAN**	**RAJ-3077**	**NW-1014**	**UP-2425**	**MEAN**	**RAJ-3077**	**NW-1014**	**UP-2425**	**MEAN**
T_1	**1.21**	**1.31**	**1.31**	**1.29**	**1.27**	**1.29**	**1.27**	**1.27**	**1.118**	**1.236**	**1.298**	**1.217**
T_2	**1.27**	**1.35**	**1.28**	**1.30**	**1.27**	**1.35**	**1.46**	**1.36**	**1.207**	**1.285**	**1.312**	**1.268**
T_3	**1.28**	**1.35**	**1.46**	**1.37**	**1.35**	**1.37**	**1.47**	**1.39**	**1.245**	**1.293**	**1.324**	**1.287**
T_4	**1.38**	**1.35**	**1.47**	**1.37**	**1.36**	**1.37**	**1.53**	**1.42**	**1.323**	**1.295**	**1.346**	**1.321**
T_5	**1.36**	**1.31**	**1.52**	**1.39**	**1.36**	**1.37**	**1.54**	**1.42**	**1.357**	**1.312**	**1.379**	**1.349**
T_6	**1.29**	**1.39**	**1.52**	**1.41**	**1.37**	**1.38**	**1.56**	**1.44**	**1.369**	**1.375**	**1.412**	**1.385**
Mean	**1.28**	**1.34**	**1.53**	**1.35**	**1.33**	**1.35**	**1.47**	**1.38**	**1.270**	**1.299**	**1.345**	**1.305**
SEM±	**0.03**	**0.02**	**0.05**		**0.03**	**0.02**	**0.06**		**0.033**	**0.023**	**0.057**	
CD at 5 %	**Zn= 0.09, V=NS, V x Zn = NS**				**Zn =0.10, V=0.07, V x Zn = NS**				**Zn= 0.08, V=0.06, V x Zn = NS**			

Table 6. Effect of zinc application on carbohydrate content in leaf (mg/g dry wt.) at various growth of wheat varieties under sodic soil.

Varieties	**30 DAS**				**60 DAS**				**90 DAS**			
Treatment	**RAJ-3077**	**NW-1014**	**UP-2425**	**MEAN**	**RAJ-3077**	**NW-1014**	**UP-2425**	**MEAN**	**RAJ-3077**	**NW-1014**	**UP-2425**	**MEAN**
T_1	107.03	109.05	112.07	109.38	284..30	228.01	212.07	241.46	180.20	182.60	188.84	183.88
T_2	113.2	114.23	122.03	116.43	291.11	297.73	310.82	299.89	192.54	192.31	195.08	193.31
T_3	115.07	115.05	121.51	117.21	292.23	299.54	311.90	301.22	194.30	193.03	197.31	194.88
T_4	112.23	119.53	128.05	119.94	298.96	305.82	318.75	307.71	199.74	201.23	208.83	203.20
T_5	127.54	130.36	137.33	131.74	312.03	323.01	334.20	323.08	206.93	212.93	223.85	214.57
T_6	125.73	129.30	136.05	130.36	310.01	320.93	322.90	317.95	205.21	211.07	221.74	212.67
Mean	116.77	119.59	126.17	120.84	298.04	262.51	285.11	281.88	196.49	198.86	205.91	200.42
SEM±	2.791	1.973	4.834		6.448	4.559	11.168		0.037	0.026	0.64	
CD at 5 %	Zn = 0.019, V = 0.013, V x Zn = NS				Zn=18. 53, V=13.10, V x Zn = 32.09				Zn=13.54, V=NS, V x Zn = NS			

RESULTS AND DISCUSSION

Overall the results indicated that Sodicity decreased the plant height in all the wheat varieties which was taken in the investigation. The maximum plant height was observed with the basal application of 25 kg & 15 kg Zn SO_4 ha^{-1} followed by 1% and 1.5% seed soaking $ZnSO_4$ and 1% $ZnSO_4$ +2.5% Urea spray. Higher plant height was observed in variety UP-2425 as compared to other varieties, it may be because of genetical characters of the varieties. Similar findings are in agreement with Patel et al. (1995) and Singh et al. (1996) in which they reported that application of zinc sulphate has improved plant height significantly.

It was generally observed that plant height increased up to the stage of 90 DAS which might be because of physiology of the plant (gradual growth from germination to the maturity). Significantly higher number of tillers was found with application of 25 kg zinc and 1% seed soaking as compared to control which might be due to role of zinc particularly under sodic soil condition, where generally zinc deficiency was found variety NW-1014 performed significantly profuse tillring as compared to other verities at 30 and 60 days and maturity. Significant influence of tillers by the varieties might be due to its genetically characters coupled with positive role of zinc towards profuse tillring these results are in the accordance with that of Singh *et al.* (1996). Leaf area of the wheat crop has significant role in assimilation production and photosynthesis activities in this experiment. Leaf area of wheat is significantly influenced by application of $ZnSO_4$. The higher leaf area recorded in UP-2425 it might be due to cell elongation and cell enlargement of the leaves. The fact that zinc is directly involved in the formation of amine acid tryptophan (Tsui, 1948) itself a precursor of indole acetic acid hormone. Similar findings was also reported by Mishra and Mehrotra (1986) and Agrwal *et al*. (1977) in which they reported that application of zinc in zinc deficient soil favored expansion of leaf lamina which is indicator of leaf area expansion. Maximum total dry weight was recorded with the basal application of 25 kg/ha $ZnSO_4$ than control. The more prominent effect was observed in UP-2425 followed by NW-1014, and Raj-3077. These finding are in conformity to Singh and Shukla (1985) and Mail *et al.* (1993) who obtained similar improvement in dry matter production by leaves and stem by the use of zinc application through seed soaking, basal application and foliar spray. Increase in chlorophyll content in all the varieties up to stage of 60 DAS. The maximum increase in chlorophyll content was observed in variety UP-2425 followed by NW-1014 and Raj-3077 and with the basal application of 25 kg $ZnSO_4$ ha^{-1} Dwivedi and Mishra (1979) also reported that zinc and iron increase chlorophyll concentration in the leaf of wheat similar finding were reported by Phaselus vulgaris Marschner (1986) reported that chlorophyll content was considerable lower in zinc deficient plant in comparison to zinc sufficient plants. Singh and sigh (2004) reported that the zinc application increased chlorophyll and raised the tissue concentration of Zn, Ca, Mg, K and P whereas N content decreased. Sharms et al. (1994) observed that decreased photosynthetic rates and reduced leaf chlorophyll content in Zn deficient levels of cauliflower. The effect of zinc sulphate on carbohydrate content in wheat plant were significantly increased with various levels of $ZnSO_4$ (basal, seed soaking and foliar spray) under sodic soil. The maximum carbohydrate was recorded with the basal application of 25 kg ha^{-1} among the varieties, higher carbohydrate content was recorded in UP-2425 as compared to NW-1014 and Raj-3077. Zinc deficiency is manifested by carbohydrate metabolism has been also reported by Rai Singh (1969) who found decrease starch and protein content of wheat Ashor (1971) Observed that total carbohydrate content of wheat was increased by spray of zinc application also increased the synthesis and translocation of carbohydrate to site of grain formation.

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RESEARCH ARTICLE

IMPACT OF ANNABHAGHYA YOJANA ON WOMEN LABOUR INTENSIVE FARMING ACTIVITIES

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Abstract: Anna Bhagya Yojana Scheme was launched by Karnataka Government, as the most ambitious revised food distribution system to supply 30 kg of rice at Rs. one to nearly one crore poor families. Purpose of Anna Bhagya Yojana was to fulfil basic needs of people Below Poverty Line (BPL). In this scheme, a single card holder in the family got 10 kg rice at a rate of Rs 1/kg. Family with 2 members got 20 Kg rice and 3 got a maximum of 30 Kg rice at same price. Apart from rice, edible oils, sugar, iodized salt, kerosene and other items were also provided at concessional rates. So this helped poor people to get at least 2 square meals a day. Thus it was felt necessary to see whether the scheme had any impact on the beneficiaries and farmers.

Keywords: Farmers, Government, Karnataka, Scheme

INTRODUCTION

After implementation of this scheme the general notion was that it created labour scarcity for agricultural operation in farms of big farmers. Hence, a study was conducted to know the socio-economic status, sources of livelihood and participation of women labourers in various agricultural activities before and after the introduction of the scheme.

Objectives

1. To study the socio-economic profile and livelihood patterns of Annabhaghya Yojana beneficiaries (Women labourers).
2. To study the partcipation of women labourers in farming activities before and after implementation of Annabhaghya Sceme(Yojane)

MATERIALS AND METHODS

The study was conducted in seven districts of northern Karnataka coming under the jurisdiction of University of Agricultural Sciences, Dharwad namely Dharwad, Belagavi, Uttara Kannada, Haveri, Gadag, Bijapur and Bagalgot. The districts under this jurisdiction come under Coastal, Hill, Northern Transition and Dry zones. The crops cultivated in this area are predominantly Jowar, Wheat, Paddy, Sugarcane, Cotton, Chilli, Minor millets, Green gram, Bengal gram, Pigeon pea, and Plantation crops like fruits, Areca, Pepper and Coconut. The crops are cultivated either in rain fed condition or irrigated condition in rabi, kharif and summer seasons. The rainfall in Northern Karnataka varies from 2000 mm in hilly areas to 100 mm in Drier regions. As the Annabhagya scheme was operational in all the above districts and the beneficiaries were mostly men and women below poverty line, Thirty women farm labourers and Thirty men farmers (10 big, 10 small and 10 marginal land holders) thus comprising 210 farm women labourers and 210 farmers from seven districts form the subjects for the study. Among the farmers 70 farmers belonging to Above Poverty Line (APL) were selected for the study. The data was collected by using a self-structured, pre-tested interview schedule developed for the study purpose in consultation with experts. The data thus collected was subjected to statistical analysis using appropriate methods and tools suited for the research. Below is the interpretation of the research thus conducted?

Table 1. Socio - economic status of farm women labourers N=210

SI. No	Variables	Category	Frequency	Percentage
1	Age	Young (18-35 years)	**90**	42.85
		Middle (36-50 years)	**98**	46.60
		Old (>51 years)	22	10.47
2	Caste	SC	05	2.38
		ST	44	20.95
		OBC	161	76.66

*Corresponding Author

3	**Education**	Illiterate	**115**	54.76
		Primary class	42	20.00
		Middle school	38	18.09
		High school	10	4.76
		PUC	05	2.38
		Degree	-	-
4	**Type of family**	Nuclear	**188**	89.52
		Joint	22	10.47
5	**Family size**	Small (1-4 member)	**117**	55.71
		Medium (5-8 member)	84	40.00
		Large (9 & above)	08	3.76
6	**Family Income**	Low (up to Rs. 17,000)	**162**	**76.14**
		Semi-medium (Rs. 17,000 to Rs. 30,000)	48	22.56
		Medium Rs.30,000 to Rs. 50,000	-	-
		High (> 50,000)	-	-
7	**Marital status**	Married	**209**	**99.52**
		Unmarried	01	0.48
		Divorce	-	-
10	**Type of house**	Pacca	83	39.52
		Kaccha	**127**	**60.48**

Majority of the farm women labourers belonged to middle age (46.30 per centage) followed by young (42.30 per centage) and again majority belonged to other backward castes (75.60 per centage) with 54.00 per centage illiterates followed by primary school education 20.00 percentage. Majority of them were nuclear families (88.30%) as they got divided from joint families due to various reasons but, the major reason was to avail Govt. facilities which are given to those who are having small land holdings. Majority of respondents annual family income was low (76.14%) with 60.47 per centage kachcha type of house. Almost all were married.

Table 2. Wages received by farm women before and after implementation of the project N=210

SI. No	Per day wage (Rs.)	Before implementation of the project		After implementation of the project	
		Frequency	**Percentage**	**Frequency**	**Percentage**
1	Rs. 80 – 100	210	100.0	-	-
2	Rs. 100 – 120	-	-	110	52.38
3	Rs. 120 – 150	-	-	50	23.80

* Multiple responses are possible

It is clear from the above table that there is an increase in the amount received by the women for their labour activities as compared to the amount they have received before implementation of the project. It may be due to increase in the cost of all essential consumption materials that are required to meet the basic needs of the families.

Table 3. Women involvement in different activities to earn livelihood N=210

SI. No	Activities	Frequency	Percentage
1	Farm labour activities	125	59.52

2	Agricultural allied activities (Dairy, sheep/goat/poultry rearing)	120	54.14
3	Industrial work and other petty jobs nearby peri-urban areas.	72	34.28

* Multiple responses are possible

Women involvement in other allied activities apart from farm labour activites such as dairy (as government has increased subsidy on milk), sheep, goat and poultry birds rearing in their back yard has increased as indicated in table No 2. It may be due to the Government's increased effort and implementation of Integrated farming system activities across all the villages. This might have motivated women to involve in allied activities to meet out their family expenditures. Drought is another reason which is repeatedly affecting the study area which also might have declined involvement women labour in agricultural labour activites.

Table 4. Participation of farm women in different farming operations before and after implementation Annabhaghya Yojana N=210

SI. No	Farm activities	Before(2012-2015)		After(mid of 2015)	
		Frequency	Percentage	Frequency	Percentage
1	Cleaning of field	170	80.95	87	41.42
2	Levelling of field	20	9.52	08	3.80
3	Raising nursery beds	110	52.38	52	24.76
4	Sowing	182	86.66	120	57.14
5	Transplanting	40	19.04	28	13.33
6	Fertilizer application	128	60.95	92	43.80
7	Weeding	153	72.85	110	52.38
8	Gap filling	68	32.38	34	16.19
9	Irrigation	52	24.76	48	22.85
10	Cutting of crops	42	20.00	30	14.28
11	Picking	160	76.19	104	49.52
12	Bundle making	70	33.33	56	26.66
13	Threshing	100	50.00	61	29.04
14	Winnowing	190	90.47	63	30.00
15	Drying of grains	210	100.00	110	52.38
16	Cleaning of grains	210	100.00	125	59.52
17	Sorting/Grading	210	100.00	115	54.76
18	Processing	180	85.71	92	43.80
19	Storage	200	95.23	117	55.71

* Multiple responses are possible

Participation of Annabhaghya yojana beneficiaries in various farm activities before (2012-2015) and after (2015 onwards) indicated that after implementation of Annabhaghya yojane, there is a decline in participation of women labourers in various important farm operations and post harvest activities such as Cleaning of field Sowing, Transplanting, Fertilizer application, Weeding, Winnowing, Storage, Cleaning of grains, Sorting/Grading, Processing, Drying of grains and other activities.

Participation index shows that the decline is from 63 per cent to 37 per cent. The decline is almost 50 per cent. The close observation and discussion with the women labourer respondents was done to know the real reasons for decline as agriculture labour as source of livelihood.

The decline of participation of women labour in farm activities as expressed by the women respondents cannot be attributed to Annabhagya Yojane alone. Other factors contributing could be employment in small industries, construction work nearby their

villages. Petty jobs in cities which are less labour intensive than agriculture and attracted the women labourers as these jobs offered attractive remuneration

Table 5. Opinion of women labourers about Annabhaghya Yojane N=210

SI. No	Statements	Response	Frequency	Percentage
1.	Ration is sufficient	Yes	49	23.10
		No	161	75.90
2.	Annabhagya scheme is useful	Yes	194	92.38
		No	16	7.62
3.	Scheme should be continued.	Yes	195	92.85
		No	15	7.14
4.	Quality of the grain is good	Yes	165	77.80
		No	45	21.42
5.	If quality is not good, do you sell the ration?	Yes	202	95.30
		No	08	3.80

The above table shows that majority of the beneficiaries are demanding more food grains. The scheme is very useful because it is the only source to meet the food requirement of the family when there is no other source of livelihood. Especially during severe drought, there are no farm activities; this scheme is helping especially the poorest of the poor. Hence, they requested for continuation of the scheme with more food grains. During the study period the quantity of food grains was almost reduced to 3 kg/person as given in the beginning of the scheme i.e., 10 KG/person. Hence 2/3rd of the respondents expressed the quantity of food grains should be increased.

RESULTS

All the farm women labours have favourable opinion about the scheme as it is the only source of food when there is no alternate source of livelihood especially during severe drought. Almost all were using the food grains for family consumption. The dietary pattern changed especially morning breakfast was dominated by rice based dishes as compared to pulse dominated dishes prior to implementation of the scheme.

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RESEARCH ARTICLE

INVESTIGATIONS OF MAIZE CURVULARIA LEAF SPOT DISEASE AND ESTIMATING YIELD LOSS IN BELAGAVI, BAGALKOT AND VIJAYAPUR DISTRICTS OF NORTHERN KARNATAKA

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Abstract: Intensive roving survey was carried out in three districts (Belagavi, Bagalkot and Vijayapur) of north Karnataka, during October - November 2014. Overall the disease severity was low in all the three districts surveyed and it was ranged between 2.44 to 9.02 per cent. Maximum disease severity of 9.02 per cent was recorded in Belagavi district followed by Bagalkot (5.31%) and Vijayapur (2.44%). Among the taluks Gokak had the maximum disease severity (9.83%) followed by Saundatti (8.97%), Jamakhandi (8.75%) and Raibhag (8.27%) and it was least in Indi (1.80%). Among different genotypes, irrespective of the fungicidal spray significantly higher per cent disease index was recorded in the genotype CP 818 (38.27 %) compared to other genotypes. Next genotype which was recorded higher per cent disease index was Arjun (36.20%) followed by CP 808 (34.64%), Shimsha 517 (34.55%), and Kaveri 244 (34.25%) and were on par with each other and least per cent disease index was recorded in the genotype DKC 9133 with severity of 15.08 per cent.

Keywords: Curvularia leaf spot, *Zea mays*, Karnataka, Survey

INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crop globally grown after wheat and rice. Due to the introduction of high yielding indigenous and exotic hybrids and along with use of fertilizers, there has been a phenomenal increase in the area and production. Maize kernel contains about 77 per cent starch, two per cent sugar, nine per cent protein, two per cent ash on a water free basis, five per cent pentosan and five per cent oil. It has more than 1000 industrial uses and mainly used for production of starch due to its high starch content of 77 per cent. Maize seed oil contains the highest polyunsaturated fatty acids (PUFA), linoleic acid (61.99%) and it remains as liquid at fairly low temperature which is helpful in combating heart disease. Maize seed oil is also low in linolenic acid (0.7%) and contains a high level of natural flavor.

It is mainly cultivated in the states of Andhra Pradesh, Karnataka, Bihar, Rajasthan, Madhya Pradesh, Gujarat, Chhattisagarh, Maharashtra, Tamil Nadu and Uttar Pradesh. It is also widely believed that, in the very near future maize may become a staple food for human consumption if the demand for rice and wheat is not fulfilled through increased production. It is mainly grown in the districts of Bagalkot, Belagavi, Dharwad, Gadag, Haveri, Bellary, Mysore, Chitradurga and Shimoga districts.

In India new leaf spot disease of maize incited by *Curvularia clavata* Jain has been reported from Varanasi region (Mandokhot and Basu Chaudhary, 1972). It was reported to cause a yield loss up to 60 per cent under inoculated conditions (Grewal and Payak, 1976). The disease incidence was recorded from four places in Uttarakhand. It was recorded in severe condition from Haridwar and Dehradun whereas from Kashipur and Haldwani it was recorded in moderate to traces. Extensive survey conducted in Rajasthan during *kharif* 2010 reveald that the incidence of *C. lunata* was in severe to moderate in villages like Lohira, Kavita, Iswal, Ghiyara and Baswara. Disease incidence was high in Rajasthan area due to high rain fall and high humidity (Anon., 2011). Keeping this in view, the present investigation was under taken with the prime objective of Roving survey to identify the hot spots for maize Curvularia leaf spot in northern parts of Karnataka.

MATERIALS AND METHODS

Intensive roving survey was carried out in three districts (Belagavi, Bagalkot and Vijayapur) of north Karnataka, during October - November 2014. The maize fields on the survey route were visited and the observations on Curvularia leaf spot (CLS) severity, stage of the crop and the condition under which the crop was grown (rainfed or irrigated) was noted down.

The severity of Curvularia leaf spot disease was recorded by using 0 - 9 scale of Mayee and Datar (1986).

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Scale:

Rating value	Description
0	No symptoms on the leaf.
1	Up to 1% of leaf area covered with leaf spots
3	1-10% of leaf area covered with leaf spots.
5	11-25% of leaf area covered with leaf spots.
7	26-50% of leaf area covered with leaf spots
9	More than 50% of leaf area covered with leaf spots

Further, these scales were converted to per cent disease index (PDI) using the formula given by Wheeler (1969).

$$\text{Per cent disease index (PDI)} = \frac{\text{Sum of the individual disease ratings}}{\text{Number of leaves assessed} \times \text{Maximum grade}} \times 100$$

Sample collection and isolation of the pathogen

Maize leaves infected by *Curvularia lunata* with typical round or oval shaped lesion surrounded by a wide translucent straw yellow halo showing leaf samples were collected from the farmers field nearer to College of Agriculture, Vijayapur during *kharif* 2013. The pathogen was isolated following standard tissue isolation technique as mentioned below.

The infected leaf bits along with some healthy portions were surface sterilized in 1:1000 mercuric chloride solution for 30 sec and washed thoroughly thrice in sterilized distilled water to remove the traces of mercuric chloride, if any. Then such bits were aseptically transferred to sterilize Potato Dextrose Agar (PDA) Petridishes. The Petridishes were incubated at room temperature (28±1°C) and observed periodically for fungal growth. The pure colonies which developed from the bits were transferred to PDA slants and incubated at room temperature for 10 days.

Single spore isolation

This method was followed for maintaining pure culture, as this fungus is multi-celled and known for heterokaryotic in nature. Dilute spore suspension (8-10 spores/ml) was prepared in sterile distilled water and one ml of such suspension was spread uniformly on two per cent water agar plates before its solidification. Single spore was marked with the ink and was allowed to germinate. Such plates were incubated at 28±1^{0}C and periodically observed for germination of spores. Hyphal initials/threads emerging from each end cell of the single spore was traced and marked with the ink. Then tip of the hyphae was cut with sterile cork borer and transferred to the PDA slants and incubated at 28 ± 1^{0}C for 10 days. Thus obtained culture was used for further studies.

Maintenance of the culture

The fungus was sub cultured on PDA slants and kept at 28±1^{0}C for 10 days and such slants were preserved in refrigerator at 5^{0}C and renewed once in 30 days.

Proving the pathogenicity

The *C. lunata* was multiplied in potato dextrose broth. Ten days old fungal growth was homogenized in sterilized warring blender with sterilized distilled water and was filtered through muslin cloth. The spore suspension along with mycelial bits were sprayed with automizer on 20 days old maize plants of the hybrid Dekalb grown in earthen pots (50 × 30). The inoculated plants were then covered with polythene hoods for 48 hr to create high humidity. Plants of same aged sprayed with sterilized water served as control. Observations were made at regular intervals for the development of symptoms. The fungus was re isolated from infected leaves and the culture obtained was compared with the original culture to confirm identify.

Table 1. Severity of maize Curvularia leaf spot in Belagavi, Bagalkot and Vijayapur districts of Karnataka during *kharif* 2014

District	Taluk	Village	Stage of the crop	Crop grown condition	Percent disease index
Vijayapur	Vijayapur	Aheri	Cob development	Rainfed	4.88
		Ankalagi	Cob development	Rainfed	1.80
		Chikkanura	Cob development	Rainfed	3.40
		Mean			**3.36**
	Indi	Atharga	Cob development	Rainfed	2.40
		Jambagi	Cob development	Rainfed	1.80
		Thamba	Cob development	Rainfed	1.20
		Mean			**1.80**

	Sindagi	Khadalewada	Cob development	Rainfed	0.96
		Neevalkeda	Cob development	Rainfed	2.27
		Devarhipparagi	Cob development	Rainfed	3.44
		Mean			**2.21**
	Basavana Bagewadi	Basavana Bagewadi	Cob development	Rainfed	2.33
		Ingaleshwar	Cob development	Rainfed	2.77
		Muttagi	Cob development	Rainfed	2.14
	Mean				**2.41**
	District average				**2.44**
Bagalkot	**Bagalkot**	Rampur	Cob development	Rainfed	1.90
		Bevura	Cob development	Rainfed	2.08
		Thimmappur	Cob development	Rainfed	1.68
	Mean				**1.88**
	Jamakhandi	Hunnur	Cob development	Irrigated	7.91
		Kadapatti	Cob development	Irrigated	8.68
		Jamakhandi	Cob development	Irrigated	9.66
	Mean				**8.75**
	District average				**5.31**
Belagavi	**Saundatti**	Saundatti	Cob development	Irrigated	8.06
		Munnoli	Cob development	Irrigated	8.82
		Yaragatti	Cob development	Irrigated	10.03
	Mean				**8.97**
	Gokak	Arabhavi	Cob development	Irrigated	10.75
		Kalloli	Cob development	Irrigated	9.81
		Mudalagi	Cob development	Irrigated	8.95
	Mean				**9.83**
	Raibhag	Kankanwadi	Cob development	Irrigated	8.63
		Mugalkhod	Cob development	Irrigated	8.39
		Harugeri	Cob development	Irrigated	7.80
	Mean				**8.27**
	District average				**9.02**

Table 2. Per cent disease index (PDI) in maize genotypes as influenced by fungicidal spray

Genotype	Protected	Un protected	Mean	Percent decrease over unprotected
CP 818	8.48 (16.93)*	68.06 (55.58)	**38.27 (37.22)**	87.54
CP 808	4.80 (12.65)	64.48 (53.42)	**34.64 (36.05)**	92.56
NK 6240	2.50 (09.09)	42.28 (40.56)	**22.39 (28.24)**	94.08
900M Gold	3.59 (10.92)	50.90 (45.52)	**27.25 (31.46)**	92.95
Prabal	2.46 (09.02)	55.61 (48.22)	**29.03 (32.60)**	95.98
Super 900M	6.36 (14.60)	35.05 (36.30)	**20.70 (27.06)**	81.85
Pinnacle	3.41 (10.63)	56.48 (48.72)	**29.94 (33.17)**	93.96
DKC 9133	1.70 (07.48)	28.47 (32.24)	**15.08 (22.85)**	94.02
All-rounder	2.82 (09.66)	43.68 (41.37)	**23.25 (28.82)**	93.54
Shimsha 517	7.72 (16.13)	61.39 (51.58)	**34.55 (36.00)**	87.42
Kaveri 244	4.61 (12.40)	63.89 (53.06)	**34.25 (35.82)**	92.78
Mograon	3.26 (10.39)	59.28 (50.35)	**31.27 (34.00)**	94.50
Arjun	6.67 (14.97)	65.74 (54.17)	**36.20 (36.99)**	89.85
GH 0727	6.50 (14.77)	57.78 (49.47)	**32.14 (34.53)**	88.75
MAH 957	5.36 (13.39)	49.99 (44.99)	**27.68 (31.74)**	89.28
Mean	**4.68(12.49)**	**53.54(47.04)**		
For comparing mean	**S.Em±**	**C.D. at 5%**		
Fungicidal spray(F)	**2.29**	**6.83**		
Genotype(G)	**3.05**	**8.84**		
Interaction (F×G)	**4.31**	**12.50**		

Interaction at the same or different level	**4.25**	**12.34**		

* **Arc sine transformed values**

RESULTS AND DISCUSSION

Roving survey was conducted during October – November 2014 in different taluks of Belagavi, Bagalkot and Vijayapur to know the severity of Curvularia leaf spot of maize in farmers fields. The results are presented in Table 1.

Overall the disease severity was low in all the three districts surveyed and it was ranged between 2.44 to 9.02 per cent. Maximum disease severity of 9.02 per cent was recorded in Belagavi district followed by Bagalkot (5.31%) and Vijayapur (2.44%). Among the taluks Gokak had the maximum disease severity (9.83%) followed by Saundatti (8.97%), Jamakhandi (8.75%) and Raibhag (8.27%) and it was least in Indi (1.80%).

In Vijayapur district maximum disease severity of 3.36 per cent recorded in Vijayapur taluk followed by Basavan Bagewadi (2.41%), Sindagi (2.21%) and Indi (1.80%) taluks. Least disease severity of 1.20 per cent was recorded in Thamba village of Indi taluk. Jamakhandi taluk recorded maximum disease severity of 1.88 per cent was recorded in Bagalkot taluk of Bagalkot district. In Belagavi district maximum disease severity of 9.83 per cent was recorded in Gokak taluk followed by Saundatti (8.97%) and Raibhag taluk (8.27%).

Among the villages, Arabhavi of Gokak taluk recorded highest disease severity of 10.75 per cent followed Kalloli (9.81%) and Mudalgi (8.95%) villages of the same taluk.

In general disease severity was more in crop grown under irrigated conditions as compare to rainfed.

The differences in the per cent disease index as influenced by different genotypes were found significant. The differences in (Table. 2) the per cent disease index in protected block was found significantly lower (4.68 %) compared to unprotected block (53.54 %).

Among different genotypes, irrespective of the fungicidal spray significantly higher per cent disease index was recorded in the genotype CP 818 (38.27 %) compared to other genotypes. Next genotype which was recorded higher per cent disease index was Arjun (36.20%) followed by CP 808 (34.64%), Shimsha 517 (34.55%), and Kaveri 244 (34.25%) and were on par with each other and least per cent disease index was recorded in the genotype DKC 9133 with severity of 15.08 per cent.

The differences in the PDI within the genotype, CP 818 recorded higher per cent disease index (8.48 %) and it was on par with Shimsha 517(7.72%), GH 0727 (6.50%), Arjun (6.67%), and by GH 0727 in protected block. Similarly the genotypes CP 818 was recorded significantly higher PDI (68.06 %) compared to other genotypes in unprotected block.

Among all genotypes, CP 818 was recorded significantly higher PDI (8.48%) in protected block as well as in unprotected block (68.04 %).

Among the genotypes, highest decrease in per cent disease severity over unprotected block was recorded in the genotype Prabal (95.98 %) followed by Mograon (94.50 %).Lowest decrease in per cent disease index was recorded in Super900M (81.85%). This suggests the need for avoiding timely losses due to CLS disease in maize. Therefore indicates that, the yield loss not only depends on the level of severity alone but also on disease tolerance of genotype. It shows that the loss in yield at the same level of disease severity may vary from genotype to genotype. Therefore, host plant resistance is an important component which is quite effective in mitigating the losses caused by the disease. Upto 60% losses in grain yield of maize due to Curvularia leaf spot have been reported both in China and India (Hai *et al*., 1995 and Grewal and Payak., 1976). Cui and Sun (2012) estimated that yield loss in lotus was 10 to 15% due to Curvularia leaf spot.

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RESEARCH ARTICLE

CONSTRAINTS FACED BY FARMERS DURING PRODUCTION AND MARKETING OF MAJOR OILSEEDS IN RAIGARH DISTRICT OF CHHATTISGARH STATE

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Abstarct: Oilseeds occupy a unique position in Indian agriculture. India is one of the largest producers of oilseeds in the world. An attempt has been made in this paper to finding the production and marketing constraints of major oilseeds in Raigarh district of Chhattisgarh state with ninety farmers who were selected randomly from six villages. From each of the village fifteen farmers considered to collect the required information. Major constraints pertaining to cultivation of oilseeds were lack of resources (81.12 per cent) is generally faced by small category farmers. Due to this reason, these farmers are not able to invest for better production technology. Lack of recommended package and practices particularly doses of fertilizer, insecticides and pesticides are perceived by 77.78 per cent of producers. About 67 per cent farmers faced this problem. According to them this step will also prove very useful in improving the productivity of this crop at one side and in reducing the per hectare cost of cultivation on the other. There is technological gap because the extension wing of department of agriculture is not making proper and sincere efforts to disseminate the technical know-how from research stations to the farmer's fields. Lack of implementation of support price in the villages is the major problem faced by major oilseeds producers. Almost all farmers told that no any intermediary is prepare to give the support price if produce is sold by farmers in the villages. When they were asked that why you do not sale your produce in the market? More than 52 per cent producers perceived that transportation of small quantity of produce may not an economical if they sell this small produce in the market. More than 93 per cent producers told that the presence of itinerant traders in the producing area is only for limited period after harvesting the crop.

Keywords: Area, Production, Oilseed, Constraints, Marketing, Farmer

INTRODUCTION

India is the third largest edible oil producing country in the world after the united nation and china. It occupies a distinct position not only in terms of area under oilseeds with agro-ecological conditions favorable for growing nine major oilseeds indicating seven edible oilseed i.e. groundnut, rapeseed, mustard, soybean, sunflower, safflower, sesame, niger and two non-edible sources namely castor and linseed apart from wide range of other minor oilseeds and oil bearing tree species. The country's demand of the vegetable oils is expected to increase from the current level of the 13 million tones to14.8, 18.3 and 21.8 million tons by 2010, 2015, and 2020, respectively. (Oilseed situation of India).The total oilseeds area, production and productivity was 22.7 million hectares, 18.4 million tons and 810 kilogram per hectare respectively during 2000-01, which increased to 27.6 million hectares, 27.7 million tons and 1006 kilogram per hectare during 2008-09. It is heartening to note that the significant growth in production is coming from the yield effect. It is welcoming sign as the area for cultivation is limited. The advance estimates reveals that the kharif oilseed production will meet the set targets of the year 2010-11. (Narayan P. *et al*., 2011).The significant improvement in annual growth in area and yield under total nine oilseed crops during 2000-01 to 2008-09 as compared to period of 90s has resulted in increase in the annual growth rate of production of oilseed, but at the same time the import of oilseeds oil hovering between 40-50 per cent of total agricultural imports by India.

Consumption of oilseeds assuming normal conditions in marketing year 2013/14, total feed waste is expected to grow 6 percent to 11.9 million tons. This includes 3.8 million tons of cottonseed meal (mostly used for livestock feed), 3.2 million tons of soybean meal, 2.7 million tons of rapeseed meal, 1.5 million tons of peanut meal, and 700,000 tons of other oil meals.(grain report GAIN,2013/14) The consumption of edible oils is rising continuously, outstripping the domestic production resulting in huge imports. During 2011-12, the country imported about 9.2 million tons of edible oils which was about half of its domestic requirement. Edible oil demand is projected to reach 16.64 million tons by the terminal year (2016-17) of the XII plan.

MATERIALS AND METHODS

Sampling Procedure: Chhattisgarh state comprises 27 districts. Out of which Raigarh district contributes

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13 percent in area and 16 percent production of three major oilseeds. Therefore Raigarh district as selected purposively. The total area of groundnut, sunflower and mustard crop in Raigarh district is 6979, 2090 and 1475 hectare. Production is 8820, 439 and 645 metric tonnes respectively. The district has 9 block namely Raigarh, Sarangarh, Dharmjaygarh, Gharghora, Lailunga,Kharsia, Baramkela, Pusaur and Tamnar. Out of these three block had selected purposively as these has highest area and production according to crop namely Baramkela selected for groundnut (1608 ha), pusaur selected for sunflower (716 ha) and Lailuga bock selected for mustard (433 ha).In these block the major oilseed being grown in about 100 villages in each block. The sample of two per cent was considered for the study purpose from each village therefore 6 villages were selected for the study purpose.

Total population of these village is 2844 and in this population major oilseed growers are about 749 (26.33 per cent) .Sample of 15 farmers from the each village were selected therefore 90 (8.33 per cent) farmers were selected through size to proportionate method for the study purpose.

Data Collection: The primary data is collected from the oilseed producers through personal interview method with the help of well prepare scheduled and questionnaire for the production and marketing year 2012-13. The primary data included information regarding the general information, land utilization pattern, source of irrigation, cropping pattern, production, productivity and cost of cultivation. Cost of cultivation included variable and fixed cost. The variable cost consists of field preparation, sowing, fertilizer and manure, inter-culture, plant protection, irrigation, harvesting and threshing while the land revenue and interest on working capital are considered as fixed cost. The questionnaire includes major problems related to production and marketing of major oilseed crop.

RESULTS AND DISCUSSION

Constraints in Production of major oilseeds: The constraints in major oilseeds production are presented in Table 1. Major constraints pertaining to cultivation of oilseeds were lack of resources (81.12 per cent) is generally faced by small category farmers. Due to this reason, these farmers are not able to invest for better production technology. Here is a need for creation of growers co-operative societies which can cater the needs of the farmers related to crop production. Lack of recommended package and practices particularly doses of fertilizer, insecticides and pesticides are perceived by 77.78 per cent of producers. Farmers told that timely advice in this direction may improve the production of crop. They further perceived that soil-testing facilities should be created by the Department of Agriculture at atleast block level in order to test the soil fertility of land. The scarcity of labour is another problem as 56 per cent of farmers perceived it.

Lack of financing at reasonable rate of interest is also a constraint as about 37 per cent producers are facing this problem. This problem can be overcome by financial institutions through providing the loan to the farmers at their doorstep. They are of an opinion that it is inconvenient and time taking procedure to get the money from financial institutions. Consequently, they are forced to take required money from money lenders of village at higher rate of interest in order to fulfill their crop requirement. More than 50 per cent farmers told that irrigation is not required in the crop if the rainfall is there with an appropriate regular interval during kharif season. According to farmers in the absence of adequate rainfall, they face scarcity of irrigation water in the mid reach and tail reach region of the study area as the canal water cannot reach to their fields. About 48 per cent producers reported that they are not aware about the name and quantity of needed insecticides and pesticides in case if their crop is infested by any disease or pest. In such conditions, they are completely depending on the shopkeeper who sells the insecticides/pesticides. About one third farmer's think that the varieties of crop are very limited. According to them some more varieties of major oilseeds should be evolved which may give good yield of this crop in the study area.

Table 1. Production problems faced by the Major oilseed growers

S.No.	Problems	Number of Respondents	
		Yes	No
1.	Lack of resources i.e. money	73 (81.12)	17 (18.88)
2.	Lack of recommended doses of fertilizers, insecticides and pesticides	70 (77.78)	20 (22.22)
3.	Lack of sufficient soil testing facilities	61 (67.77)	29 (32.23)
4.	Scarcity of labour during peak season	50 (55.56)	40 (44.44)
5.	Lack of irrigation water	48 (53.33)	42 (46.67)

6.	Lack of latest technical knowledge about the crop	43 (47.78)	47 (52.22)
7.	Lack of financing at reasonable rate of interest	34 (37.78)	56 (62.22)
8.	Lack of improved and high yielding varieties	30 (33.33)	60 (66.67)

Note: Figures in parentheses indicate percentage to total respondents.

Constraints in marketing of major oilseeds: Marketing constraints are presented in Table 2. Lack of implementation of support price in the villages is the major problem faced by major oilseeds producers. Almost all farmers told that no any intermediary is prepare to give the support price if produce is sold by farmers in the villages. When they were asked that why you do not sale your produce in the market?

More than 52 per cent producers perceived that transportation of small quantity of produce may not an economical if they sell this small produce in the market. More than 93 per cent producers told that the presence of itinerant traders in the producing area is only for limited period after harvesting the crop. They told during the course of study that if few of us want to store the produce, it will be difficult to sell it in future in the absence of these traders. About 46 per cent farmers feel that lack of awareness about the market information is also a problem. They suggested that the major oilseeds cell should come forward to give the news about the prices and other aspects of oilseeds in the daily newspaper, *Doordarshan* and *Akashwani*. Probably, due to all these reasons, major oilseed producers have received low price of their produce. Though, this is true for all farmers of the study area, however, about 26 per cent farmers raised this problem when they were asked. About half of the farmers were of the opinion that the crop of groundnut is less profitable due to these marketing problems as compared to paddy production in the same type of land situation.

Table 2. Marketing problems faced by the major oilseed growers

S.No.	Problems	Number of Respondents	
		Yes	No
1.	No implementation of support price in village sale	90 (100.00)	-
2.	Forced sale due to lack of market intermediaries after long time of harvesting	84 (93.33)	6 (6.67)
3.	Not economical transportation due to small quantity of produce	47 (52.22)	43 (47.78)
4.	Less profit from the crop	44 (48.89)	46 (51.11)
5.	Lack of awareness about market information	42 (46.67)	48 (53.33)
6.	Low price realized by farmers	24 (26.67)	66 (73.33)

Note: Figures in parentheses indicate percentage to total respondents.

CONCLUSION AND RECOMMENDATIONS

Chhattisgarh state comprises 27 districts, Out of these Raigarh district contributes 13 percent in area and 16 percent production of oilseeds. Farmers of major oilseeds of the district need to the regulated market to they can sale at the rate of minimum support price this action will control the diversification of the oilseed growers from other less beneficial crop. On the other hand Oilseeds are the important agricultural commodity next only to cereals in the country. There is huge demand for edible oil in the country due to increase in the per capita oil consumption. To meet this demand and to reduce the huge foreign exchequer in importing edible oil, there is an urgent need to increase the domestic oilseed production of the country. An assessment of exploitable yield reservoir available in oilseeds implies that there is a scope for doubling the oilseed production of the country. However, this can be possible by complete adoption of improved oilseed production technologies by the oilseed growers. A thorough review on adoption behavior of oilseed growers reveals that there is scope for improving the adoption behavior of oilseed growers. This foot needs intensive transfer of technology efforts. However, there are certain lacunae exist in public sector in transfer of technology efforts. The strategies to improve transfer of technology efforts targeting oilseed are also suggested.

- The farmers should be motivated to participate more in the extension activates like training, demonstrations, exhibition, agriculture quiz programs and farmers fair etc., so that they may have opportunity to learn new technology related to oilseed production technology.

- The farmers should be motivated to adopt HYVs that are stable, hardy to adverse climate conditions and resistant to insect-pest and disease.
- The credit facility should be made available to the farmers on lower interest rate so that they can easily adopt the new technologies.
- The initiating of co-operative marketing is the answer to improve the bargaining power of groundnut producers in order to realize a good price of their produce.

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SHORT COMMUNICATION

AN UPDATES TO GREENHOUSE EFFECT AND GREEN HOUSE GASES

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Abstract: Warming of the lower atmosphere (troposphere) and earth's surface is due to greenhouse effect. It is a natural phenomenon and vital to life. An increase in the concentration of greenhouse gases in the atmosphere may lead to problems. The present article is an introduction and updates to the concept of greenhouse effect and greenhouse gases.

Keywords: Atmosphere, Greenhouse effect, Greenhouse gases, Energy

INTRODUCTION

An increase in the amount of certain gases particularly synthetic gases results in the absorption of infrared radiations reflected from the surface of the earth. This leads to an enhanced heat-trapping capacity of the atmosphere, a phenomenon called greenhouse effect with a consequent increase in global temperature. One of the major consequences of this is melting of snows in the Polar Regions and increases in global sea-level. The gases responsible for greenhouse effect are called greenhouse gases.

Radiant energy

The main forms of energy are (1) Radiant energy (2) Heat energy (3) Chemical energy (4) Mechanical energy.

The source of all energy for the living being on the earth is the sun. Nuclear fusion of hydrogen atoms into helium atoms in the sun produces enormous amounts of energy which is radiated out in all direction in the form of electromagnetic radiations called solar radiation or solar energy. A very small portion of this radiation (solar energy) reaches into the earth's atmosphere. Radiation in the wavelength range 390 nm to 720 nm is visible. We are receiving energy continuously from the sun through electromagnetic radiation. Out of the electromagnetic radiation that reaches earth's atmosphere is dissipated[1] :

(1) 30% reflected back to the space
(2) 47% absorbed by atmosphere land and seas
(3) 23% used in evaporating water
(4) <1% of the remained radiation drives the wind and streams
(5) 0.01% (approximate) of radiation is used in photosynthesis.

Greenhouse Effect-basic Idea

Warming of the lower atmosphere (troposphere) and earth's surface by a complicated process that involves sunlight, gases and particles in the atmosphere is termed as greenhouse effect.

Electromagnetic radiations of short wavelength (320-390 nm, visible and short 1R) from the sun when comes to the earth's atmosphere, near about one third of it is reflected back to the space. Out of the remaining radiations some absorbed by the atmosphere. But mostly are absorbed by the surface of the earth. Now the earth radiates radiations of longer wavelengths (2000-40,000 nm). The earth here is acting like a back body and a good radiator. In accordance with the nature of black body, the earth absorbs all the radiations coming to it and radiates radiations of longer wavelengths to outer area[2].

The wavelength of radiation emitted depends on the temperature of radiating body. Sun which is very hot emits radiations of short wavelengths (UV, visible and short 1R). Almost all these radiations after passing through the earth's atmosphere reach to the surface of the earth and warms it. The earth is nowhere nearly as hot as sun.

Now the earth radiates the heat back into the atmosphere in the form of radiations of long wavelength (IR or heat) which is much more easily absorbed by the earth's atmosphere as completed to short wavelength radiation thereby increasing the temperature of the surface of the earth[3].

A part of the IR or heat energy radiated by the earth goes to the space but much of it does not passes through the layers of atmosphere's greenhouse gases to outer space and gets absorbed by the greenhouse gases present in the atmosphere. This heats up the earth's atmosphere and helps to warm the earth's surface and troposphere, maintaining it more (33°C) warmer than it would otherwise be (-18°C). This natural greenhouse effect is vital to life.

Advantage of Green-house Effect

Life on the earth is not possible without the natural greenhouse effect as it maintains earth's average temperature of 15°C a more hospitable instead of -18°C. Therefore, credit of life on the earth goes to greenhouse gases. But when concentration of greenhouse gases in the atmosphere increase problem arises[4].

Named "Greenhouse Effect"

In cold places plants, flowers, vegetables and fruits are grown in glass covered areas called greenhouse. A greenhouse (glass house) remains warms even when the temperature of outside stays low. Sunlight

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enters in greenhouse through transparent glass and strike the ground. It is not possible for the reflected 1R radiation or heat to transmit out through glass as a large portion of 1R is absorbed by the glass. This absorbed 1R warms the interior of greenhouse to take care of its ground plants and other contents. The natural greenhouse[3] on a global scale is similar to a greenhouse and the activity of atmospheric greenhouse gases resembles to the activity of glass panels of a greenhouse.

Properties required for gas to become a Greenhouse Gas

Greenhouse gases are transparent to visible light only but can absorb much of re-radiations i.e. radiations of long wavelength radiations (4000-20,000 nm). The properties needed for a gas to become greenhouse gases may be summarised as here under[5]:

1. Dipole nature of the gas.
2. Extremely strong, broad absorption band spectrum of the gas which overlaps with some of the wavelengths of heat radiations.
3. Transiction between vibrational energy levels.
4. Vibrational molecular spectrum of the gas should be produced.
5. Vibrational-rotational spectrum of the gas should be produced.

CO_2 and gases like CO_2 have an extremely strong, broad absorption band spectrum. Absorption of electromagnetic radiation in the infrared region by a greenhouse gas leads to the transitions between the vibrational energy levels of that gaseous molecular spectrum. But transition between two vibrational energy levels is accompanied by a change in rotational energy level and thus that gaseous molecule produce vibration-rotation molecular spectrum. Two types of vibrational frequency are noticed viz.

(i) Bond streching vibration: Streching of bonds takes place in bi-atomic molecules.

(ii) Angle bonding vibration: A change within a angle takes place in tri-atomic molecules[6].

Sources, relative contribution and effectiveness of Greenhouse Gases

Atmosphere greenhouse gases are found in nature. New sources of greenhouse gases as well as emission of completely new greenhouse gases come from modern industry and lifestyle. Carbon di-oxide, methane, Nitrous Oxide, Ozone, Halocarbons and water vapour are the most important greenhouse gases.

Methane (CH_4)
Carbon di-Oxide (CO_2)
Nitrous Oxide (N_2O)
Halocarbons
Surface Ozone (O_3)
Water Vapour

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SHORT COMMUNICATION

GLOBAL WARMING, CLIMATE CHANGES AND PREVENTIVE MEASURES

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Abstract: The present article is an introduction to the concept of greenhouse gases, global warming and its effect and measures to reduce global warming. The earth's climate is changing constantly. Warming of earth's surface is due to greenhouse effect. It is a natural phenomenon and vital to life. The drastic increase in the emission of CO2 within the last 30 years caused by burning fossil fuels has been identified as the major reason for the change of temperature in the atmosphere. More than 80% of the world-wide energy demand is currently supplied by the fossil fuels coal, gas and oil. Increases in concentration of greenhouse gases in the atmosphere may lead to problems.

Keywords: Atmosphere, Global warming, Greenhouse gases, Greenhouse effect

INTRODUCTION

A change in the "average weather" of a given area is called climate change and the change in the climate of the earth is global climate change. It is scientific method to define as the increase in temperature of earth that causes change in our climate. More than 20 years to broadly accept that mankind is causing global warming with the emission of greenhouse gases. The earth's climate is changing constantly naturally. Today's climate change differs from the earlier both in its rate and magnitude.

Effect of Global Warming

To search an international consensus of scientific opinion on climate change, its impact and possible responses an intergovernmental panel on climate change (IPCC) has been stabilized under United Nations (UN) Environment Programme. The first assessment Report (1990) of IPCC, confirmed in second report (1996) concluded that continuous addition of greenhouse gases in the atmosphere would lead to climate change and have important effect on natural and human systems. The recent report of IPCC estimated global average surface temperature.

Global Warming and Climate Change

Since 19th century earth's surface temperature have increases 0.6-12°F. This is global warming. The last 15 years have the 10 warmest years of this century. Out of these 2005 was the warmest year after 1850. Bythe year 2100, the global average surface temperature will increase by 1.0-3.5°C (about 2-6°F).

Rise in Sea Level

There is decrease in the snow cover in the North on Hemisphere and floating ice in the Arctic Ocean. Sea level has risen 4-6 inches over the past century on global level.

Rapid global warming could triple the rate of warming in the next century. The Oceans may rise another 8 inches by 2050. This is causing low-lying shorelines to recede significantly. Coastal areas would be lost. The low-lying countries with large coastal population are the most liable to be damaged: Bangladesh, Indonesia, Pakistan, Thailand, Gambia, Maldives, Mozambique, Senegal, Egypt, Surinam and peninsular India.

Rupture of Water Cycle

About 1% perception has increase over land. As the climate warms, evaporation will increase which will increase average global precipitation. In many regions soil moisture is to decline and intense rainstorm is to become more frequent that may lead to flooding. More floods contaminate water supplies with pollutants washed from disrupted treatment systems. This gives rise to infectious diseases.

Health Effects

Climate change has adverse effect on human health. It is expected to increase in mortality rates due to heat stress as the increase in duration and frequencies of heat waves. People may suffer from heat stroke, heart attacks and other worse effect by the heat. The people may be forced to migrate in hot weather regions as the heat may become unbearable.

Smoke particles and harmful gases could binger in air in hot stagnant condition and accelerate chemical reactions producing other pollutants. These conditions increase the risk of respiratory diseases like bronchitis and asthma.

It is likely that due to climate change infections disease including malaria, dengue covering the range of insects carrying these diseases may be potentially transmitted into the temperate zone including parts of the United States, Europe and Asia. It is estimated that zone of potential malaria transmission may enlarge from an area 45% of the world population to 65% by the end of 21st century. Thus an addition of 50-80 million cases of malaria per year.

Change in natural ecosystem and Forest: A climate change may be strictly harmful to earth's ecosystem. The change may make it difficult few many species to survive in the areas they now in habit. Some may

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be forced to migrate while others may lose their existence.

Challenges to the food supply and agriculture: Changes in crop yields and productivity are expected in response to climate change in different regions. There may be an extreme scarcity of food particularly in subtropical and tropical semi-arid and arid locations.

Suggested standard to reduce emissions of Greenhouse Gases: Responsible for Global Warming

It is hand to reduce the emission of greenhouse gases but not impossible. International and Intergovernmental (IPCC) have initiated to reduce the emission of greenhouse gases. These should be legal binding on the emission of six main greenhouse gases (CO_2, CH_2, N_2O, HFCs, PFCs and SF_6) on the developed countries to an aggregate reduction of 5% on 1990 levels (Kyoto Protocol `997). This need improved high technology and additional cost to control global warming in future the following plan may be accepted.

(1) Energy efficiency should increase in production and utilization. There is need to change over to low or no carbon fuel. 60% less nitrogen oxide and 40% less hydrocarbons must be emitted by cars.

(2) To increase fuel efficiency in vehicles and to promote complete combustion in vehicles, clean fuel is needed. Therefore, oil companies will require to develop new fuels. To capture vapour during refueling small box with lid are required on board.

(3) Change over to non-fossil energy sources viz. solar, hydroelectric nuclear etc.

(4) Factories must install maximum acceptable control technology so that toxic emission must be reduced to 90%.

(5) These must be bass on the production of CFCs, halons, CCl_4 in refrigeration, air conditioners solvents etc. This will require development of alternative chemicals and recycling of chemicals.

(6) More use of non fuel vehicles like bicycle, rickshaw has been proposed will less use o private fuel vehicles.

(7) It is requested to increase afforestation through agro-forestry, social-forestry and decrease deforestation.

(8) It has been suggested that the global climate can be controlled by plankton living in water surface of world's ocean. It consumes CO_2 through photosynthesis, thereby avoiding global warming. Research has shown that a growth of plankton by a factor of 20 decreases the dissolved CO_2 level of sea water by 60%.

(9) Economists have suggested following policy to reduce the emission of global CO_2.

(a) A transferable discharge permit (TDP): According to this policy countries would be allotted CO_2 emission permits to their permitted base level emission. This will be determined by any the following measure,

(1) equi-proportionate reduction in emission (2) ability to pay criteria (3) polluter pay principle (4) equal per capita consumption

(b) Carbon tax: This would be on the carbon content of the fuel consumed. A worldwide reduction of 20% in CO_2 emission would require 45 dollar per ton carbon and further reduction to 50% will require 140 dollar per ton of carbon. This may be troublesome for developing countries.

(10) In addition to these Programme, the clean development mechanism (CDM) policy has also been proposed (Kyoto Protocol) to reduce the emission of greenhouse gases in the developing countries. Under CDM companies in the developing nations will enter into co-operative projects to reduce emissions of greenhouse gases. Companies or countries can buy less expansive emission permit from countries that have move permit than they need. This emission system imparts trade flexibility to solution of this problem.

(11) Recently, Paris agreement provides a pathway to limit temperature rise to well below 2°C, may be even 1.5°C by the end of the country. It will serve as an important tool in mobilizes developed countries.

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