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RESEARCH ARTICLE

TO STUDY THE EFFECT OF ZN, FE AND FYM ON YIELD, ECONOMICS AND NUTRIENT UPTAKE OF DIFFERENT RICE (*ORYZA SATIVA* L.) VARIETIES

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Abstract: A field experiment was carried out at research farm Institute of Agricultural sciences, BHU, Varanasi for two consecutive years during kharif seasons of 2006-07 and 2007-08. Testing variables consisting of two varieties i.e. NDR-359 and HUBR 2-1, two sources of fertilizer application i.e. 100% RFD of NPK through inorganic source and 75% RFD through inorganic and rest 25% through FYM. Two micronutrients, Zn and Fe through Zn-EDTA and Fe-EDTA were tested in different combinations either on soil or as foliar application or both @ 0.5 and 1.0 kg ha^{-1}. Amongst varieties, var. NDR-359 recorded significantly higher yield, economics and NPK uptake of rice than HUBR 2-1, while Zn and Fe uptake were significantly increased in HUBR 2-1. Fertilizer source as application of 75% RFD through inorganic and rest through FYM recoded significantly higher yield, economics and N, P, K, Zn and Fe uptake of rice than 100% RFD through inorganic source. Among the different micronutrient treatments, soil application of Zn-EDTA @ 1 kg ha^{-1} recorded significantly higher Zn uptake in rice whereas application of Fe-EDTA @ 0.5 kg ha^{-1} recorded significantly higher Fe uptake by rice as compared to other micronutrient treatments.

Keywords: RFD, FYM, Varieties, Yield attributes, Economics, N, P, K, Zn, Fe uptake

INTRODUCTION

Rice is considered back bone of food security in India and 70% of Asian country of globle lebel. Rice production constitutes the major economic activity and key sources of livelihood for the rural households of the Punjab, Hariyana, Uttar Pradesh, Bihar, Bengal and plain, where growing rice during the kharif season is a physio graphic compulsion. In Asia 90% rice is produced and consumed and the rest (10%) in USA, Africa, Australia and Europe (Tiwari, 2002). Rice is the most important cereal crop in India but its productivity is very low, particularly in eastern U.P. Out of many factors, fertilizer is still an important and inescapable input in increasing the production of rice. However, increasing cost of fertilizers has necessitated to improve the efficiency of applied fertilizers, which depends on adequate availability of most essential plant nutrients in a balanced proportion throughout the crop growth period. In recent year's use of fertilizers coupled with intensive cropping have accelerated the exhaustion of micro-nutrient reserves of soils. It has, thus, become imperative to use the matching doses of required NPK and micro-nutrients along with FYM.

Besides, increasing the productivity of rice, supplementation of micro-nutrients in fertilizer schedule also is a significant factor to improve the quality of grain to overcome certain malnutritional problems in dietary system of human beings. Accordingly its productivity, quality and profitability have become an integral part of our National Food System. Micro-nutrient malnutrition in rice is a common phenomena due to deficiency of iron, zinc, Fe, iodine and vitamin A (FAO and WHO, 2002). Rice is an especially poor source of two important minerals, calcium and iron (Welch and Graham, 1999) which is known to play significant role in formation of hemoglobin and transport of oxygen in human body. Micro-nutrients have attained a greater significance in intensive farming system with increased crop productivity for nutritional security (Rattan *et al.*, 1998). In India, among micro-nutrients, Zn deficiency is the most widespread under the area of high yielding crop varieties particularly in low land rice (Singh *et al.*, 2010). Therefore keeping this view in mind it was thought worthwhile to study the effect of Zn, Fe, and FYM on growth, yield and the content of NPK, Zn and Fe in grains of different rice varieties.

MATERIALS AND METHODS

A field experiment was conducted at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University Varanasi during *kharif* seasons of 2006-07 and 2007-08. The soil of experimental field was alluvium, neutral, having pH (7.3), low in available N (190.56 kg ha^{-1}) medium in available P (20.58 kg ha^{-1}) and exchangeable K (223.87 kg ha^{-1}) while Zn (0.898 kg ha^{-1}), and Fe (20.67 kg ha^{-1}) were deficient. The treatments consisting of 4 main plot treatments, with combination of two varieties (V_1-NDR-359 and V_2 - HUBR2-1) and two fertilizer sources (F_1-100% recommended fertilizer dose (RFD), F_2-75% RFD+25% N through FYM and 9 sub plot treatment combinations M_0 (control), M_1 (Zn as soil application through Zn-EDTA @ 1.00 kg ha^{-1}), M_2 (Zn as foliar application through Zn-EDTA @ 0.5 kg ha^{-1}), M_3 (Fe as soil application through Fe- EDTA @ 1.00 kg ha^{-}

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^{1}), M_4 (Fe as foliar application through Fe-EDTA @ 0.5 kg ha^{-1}), M_5 (Zn as soil application through Zn-EDTA @ 1.00 kg ha^{-1} + Fe as soil application through Fe-EDTA @ 1.00 kg ha^{-1}), M_6 (Zn as foliar application through Zn-EDTA @ 0.5 kg ha^{-1} followed by Fe as foliar application through Fe-EDTA @ 0.5 kg ha^{-1}), M_7 (Zn as soil application through Zn-EDTA @ 1.00 kg ha^{-1} followed by Fe as foliar application through Fe-EDTA@ 0.5 kg ha^{-1}), M_8 (Fe as soil application through Fe-EDTA @ 1.00 kg ha^{-1} followed by Zn as foliar application through Zn-EDTA @ 0.5 kg ha^{-1}) allotted in split plot design replicated three times. The duration of NDR-359 and HUBR2-1 were 130-135 days and 125-130 days respectively which were taken as a test crop and planted on a spacing of 20 × 10 cm with 2 seedling hill^{-1}. Observations on various yield parameters (number of panicle m^{-2}), grains/panicle,test weight (g) , grain and straw yield (qha^{-1}), cost off cultivation (Rs/ha^{-1}), net returns (Rs/ha^{-1}), benefit cost ratio) and nutrient uptake (N, P, K, Zn, and Fe) were done at harvest after transplantation (DAT). Estimations of N, P, K, Zn, and Fe were done by the methods given by, N (Subbiah and Asija, 1973), P and K (Jackson, 1973), Zn and Fe (L'vov, B.V, 2005), respectively. Yield and yield attributes of different treatments ha^{-1} were recorded and computed. As effect of different treatments during two years showed similar trends, pooled means of two years data were presented.

RESULTS AND DISCUSSION

Effect of varieties

Data revealed that variety NDR-359 produced significantly higher yield parameters (number of panicle m^{-2}), test weight (g), grain and straw yield (qha^{-1}) over HUBR 2-1 whereas, grains/panicle, significantly higher over NDR-359 during crop seasons (Table 1).

The cost of cultivation of aromatic and non aromatic rice (fine and coarse rice grains) varied from 29202.48 to 29577.54 Rs/ha. Owing to transplanted of different nature type of rice varieties.The cost of cultivation was the lower under V_1 (NDR-359) for variety treatment, whereas it was higher V_2 (HUBR 2-1) for variety treatment of rice. Owing to production of grain yield and comparatively lower cost (V_1), net returns (55312.55 Rs/ha) and benefit cost ratio (1.87) were the significantly highest under the V_2 (HUBR 2-1) varietal treatment during both the years.

light varietal differences were observed in N, P and K uptake of grain and straw. Variety NDR-359 recorded significantly higher N, P and K uptake than HUBR 2-1. In case of non-aromatic rice varieties, about 73% of N was translocated to grain and rest remaining in the straw while in aromatic cultivars translocation of N to grain was only 47% (De *et al.,* 2002). The results of the present study are in agreement with the findings of Subrahmanym and Mehata (1974). Application of N, P, K with micronutrients Zn and Fe are known to increase the uptake or content of N, P, K, Zn and Fe (Ganghaih *et al.,* 1999). However, micronutrients (Zn and Fe) content or uptake of variety HUBR 2-1 proved significantly superior over NDR-359 (Table 2). Varieties, HUBR 2-1 recorded maximum zinc and iron in grains and straw because it is aromatic in nature which supported the fact that zinc and iron concentrations remain higher in grains due to aromaticity of the variety. These findings are strongly supported by Graham *et al*. (1997) and (Babu *et al*. 2005).

It is well known that the application of N,P,K, micronutrients along with FYM in proper combinations might increase and synthecize, various volatile aromatic compound found in rice, responsible for its aroma. Among which 2-Acetyle-1-Pyrroline (2-AP) is the most significant. Considerable improvement in grain quality of aromatic rice was recorded under might be due to increase of aroma and nutrient content synthesizing in grain with combined use of organic and inorganic sources of nutrients as compared to 100% RFD through inorganic fertilizers. These findings are strongly supported by (Sahu *et al.,* 2007).

Effect of fertilizers

The Application of 75% RFD through inorganics + 25% N through FYM produced significantly higher yield attributes of number of panicle m^{-2}, number of grains panicle^{-1}, test weight (g) and grain yield of 54.06 qha^{-1} over 100% RFD through inorganics (49.75 qha^{-1}). Application of F_2 sources of fertilizers also produced relatively higher straw yield (75.41 qha^{-1}), as compared to F_1 sources of fertilizers at crop harvest. (Table 1). Lower sterility under the 75% RFD through inorganics + 25% N through FYM producing bolder grains thus increased the test weight due to slow release of nutrients for longer period after decomposition of FYM, which favoured better plant growth and improved the yield components of rice. Improvement in all above yield attributes and yield has also been reported by Gupta *et al*., (2009).

The cost of cultivation of aromatic and non aromatic rice varieties varied from 28960.05 to 29819.97 Rs/ha. Owing to use of different doses and sources of fertilizers. The cost of cultivation was the lowest for 100% RFD through inorganic fertilizers applied to rice, whereas it was highest when 75% RFD through inorganic+25% N through FYM. Owing to production of grain yield and comparatively lower cost (F_1), net returns (46296.48 Rs/ha) and benefit cost ratio (1.55) were the significantly highest under the application of 75% RFD through inorganic+25% N through FYM (F_2).

Application of 75% RFD through inorganic sources + 25% N through FYM proved significantly superior in increasing P, K, Zn and Fe uptake in grain and straw over F_1-100% RFD through inorganics during both the years (Table 2). The present results are in agreement with the findings of Srivastava *et al*. (2008) and Chandrapala *et al*. (2010). Organic

sources also improved the uptake of Fe by supplying chelating agents, which helps in maintaining the solubility of micro-nutrients including Fe. The response of organic matter showed profound influence on the solubility of Fe in waterlogged soil by providing resistance to Fe chlorosis (Singh *et al.*, 2010) and (Das *et al*., 2010). It is thus apparent that application and maintenance of organic matter in the soil translates adequate long term availability of Fe. Improving N nutrition of plants may contribute to increase Zn and Fe concentration in grain and straw by affecting the levels of Zn or Fe-chelating nitrogenous compound, required for transport of Zn and Fe within plants, which increased Zn and Fe transporters needed for its uptake by root and phloem loading. It indicates that nitrogen management is an effective agronomic tool to enhance grain Zn and Fe concentrations. The present results are in agreement with the findings of Cakmak[A] (2010).

Effects of Zn and Fe

Micronutrients in various mode of application produced significant variation on yield attributes, yield, economics and nutrient uptake. Incorporation of Zn and Fe either individually or in combination significantly increased the yield attributes, yield, economics and nutrient uptake over control in both the year of experimentation. The combined application of M_7 (Zn as soil application through Zn-EDTA @ 1.00 kg ha^{-1} followed by Fe as foliar application through Fe-EDTA @ 0.5 kg ha^{-1}applied in two splits at 15 DAT and at 50% panicle initiation) produced significantly higher yield attributes, yield, economics and nutrient uptake. Application of Zn and Fe in combination with FYM and recommended dose of N, P, K significantly influenced the yield attributes, yield, economics and nutrient uptake (Table 1 and Table 2). Similarly combined application of Zn-EDTA @ 1.00 kg ha^{-1} followed by Fe-EDTA@ 0.5 kg ha^{-1}applied as foliar recorded significantly higher number of panicles m-2, number of grains $panicles^{-1}$,grain and straw yield over the single or combined application of Zn-EDTA and Fe-EDTA. Test weight (g) remained statistically at par with the treatment $M_{6,}$ M_8 $M_{1.}$ Participation of Zn in biosynthesis of indole acetic acid (IAA) and its role in initiation of primordial reproductive parts and partitioning of photosynthates towards them are responsible for increased yield (Takaki and Kushizaki, 1970). The favorable influence of applied Zn on yield may be due to its catalytic or stimulatory effect on most of the physiological and metabolic process of plants (Mandal *et al.*, 2009). Iron as a constituent of the electron transport enzymes, like cytochromes and ferredoxin are actively involved in photosynthesis and mitochondrial respiration. It is also a constituent of the enzymes catalase and peroxidase, which catalyze the breakdown of H_2O_2 (peroxide released during photorespiration) into H_2O and O_2, preventing H_2O_2 toxicity. Iron, along with molybdenum, is an element of the nitrite and nitrate reductase enzymes. Thus, iron helps in the utilization of nitrogen. All these physiological processes proved instrumental in increasing yield by application of iron.

The effects of treatments were also observed significan in respect of net return and benefit cost ratio (Table 1). The magnitude of incease due to application of Zn and Fe to both in rice. Owing to net returns and benefit cost ratio were the significantly highest under the application of M_7 (Zn as soil application through Zn-EDTA @ 1.00 kg ha^{-1} followed by Fe as foliar application through Fe-EDTA @ 0.5 kg ha^{-1}applied in two splits at 15 DAT and at 50% panicle initiation) in rice was found to be net return (49120..43) and benefit cost ratio (1.64) significantly higher over to all treatments during both the years. M_1 (Zn as soil application through Zn-EDTA @ 1.00 kg ha^{-1}) and M_4 (Fe-EDTA @ 0.5 kg ha^{-1}applied in two splits at 15 DAT and at 50% panicle initiation) applied alone resulted both on par during both the years. Husain *et al.* (2009) also reported similar results.

In general, nutrient removal by rice crop was recorded mainly due to higher yield of rice and depend on nature of rice varieties, fertility and field management and practices. Incorporation of micronutrient (Zn-EDTA and Fe-EDTA) proved significantly superior to control in increasing N, P, K uptake by rice (Table 2). Application of Zn-EDTA @ 1 kg ha^{-1} in soil followed by Fe-EDTA @ 0.5 kg ha^{-1} as foliar spray in two splits recorded maximum N, P and K uptake of rice and proved superior over other treatments. Increase in nutrient uptake with the increased fertility levels could be attributed to better availability of nutrients and their transport to the plant from the soil.

Incorporation of Zn-EDTA @ 1.00 kg ha^{-1} as soil application showed significant superiority over all treatments in increasing Zn content in grain followed by M_2, M_7, M_5, M_6, $M_{8,}$ M_4. The zinc and iron content in rice grains were recorded maximum with their separate application and minimum under control whereas, combined and sequential applications of Zn-EDTA and Fe-EDTA slightly decreased Zn and Fe concentrations in grains as compared to their separate applications reported by Verma and Tripathi (1983). Jana *et al.* (2010) also observed that soil application of Zn-EDTA led to higher content and uptake of N, P, K and Zn in grain and straw of rice. Alvarez *et al.* (2001) reported that when Zn was added as Zn-EDTA, the amounts of the most labile fractions (water-soluble plus exchangeable and organically complexed Zn) increased throughout the entire soil profile column, which enhanced the root-cell membrane function. Activity of carbonic anhydrase (CA) is closely related to Zn content in C_3 plants (Pearson *et al.*, 1995). Under extreme Zn deficiency, carbonic anhydrase activity remained almost absent. The labeled Zn rapidly accumulated in the roots of cereal crops upon immersion into the isotope solution. Root uptake and root-to-shoot transport of zinc and particularly internal utilization of zinc are equally

important mechanism involved in the expression of zinc efficiency in cereal crops varieties. Since flag leaves are one of the sources of remobilized metals for developing seeds, the identification of the molecular players that might contribute to the process of metal transport from flag leaves to the seeds may be useful for biofortification purposes in relation to Zn and Fe (Sperotto *et al.*, 2010). Chandrapala *et al.*(2010), Naik and Das, (2008) concluded that the greater affectivity of Zn-EDTA over other sources of Zn in terms of growth and its utilization by plants might be due to less retention and greater transport and movement of chelated Zn to plant roots. Fe as foliar through Fe-EDTA recorded relatively higher yield and nutrient uptake over Fe as soil through Fe-EDTA at all the stages of plant growth, probably due to higher Fe uptake through aerial portion of plant under foliar spray (Sarangi *et al.*, 2006). Evaluation of Fe salts as foliar spray under different conditions showed greening effect associated with increased chlorophyll and Fe content. Subsequently, application of non-charged or negatively charged Fe-chelates for foliar sprays seems to be the most effective alternative as suggested by Fernandez *et al*. (2005).

Foliar application of Fe in two splits (M_4) produced highest Fe content in grain and proved significantly superior to all other combinations. Concurrently, incorporation of Zn-EDTA @ 1 kg ha^{-1} in soil and foliar application of Fe- EDTA @ 0.5 kg ha^{-1} showed next best affectivity in increasing Fe content over other treatments. Uptake of Zn or Fe however was reduced in combined soil as well as foliar applications of Zn and Fe which remarkably increased when applied to soil individually. This obsiously indicated antagonism between these two micronutrients when applied in combination. Further, Fe content improved due to application of N through organic sources which might be due to maintenance of better soil aeration and the solubility of micronutrients. Therefore, overall findings concluded that Zn-EDTA as soil and Fe-EDTA as foliar applied in rice contributed marked increase in yield associated with grain micronutrient content (Zn and Fe) along with their uptake as compared to other treatments and finally significantly balancing in ionic composition.

Uptake by grain and straw

The results of the present study indicated that zinc and iron content in grains and straw favourably influenced due to different treatments. Nutrient content of rice significantly increased over control due to Zn, Fe and FYM application. Zn, Fe and FYM showed synergistic effect on N, P, K, Zn and Fe content. However slight varietal differences were observed in N, P and K content of plant at flowering stage, grain and in straw. Variety NDR-359 recorded higher uptake and N content than HUBR 2-1 at flowering stage and in grain and straw, but it remained significantly higher in straw of NDR-359 during both the years. The results of the present study are in agreement with the findings of Subrahmanym and Mehata (1974).They reported that Fe application significantly increased the N content of rice. Phosphorous content and uptake at flowering stage of plant, grain and straw increased markedly in NDR-359. Similarly K content and uptake of variety NDR-359 remained significantly superior to HUBR 2-1 at flowering stage, and in grain and straw during both the years. Micronutrient (Zn and Fe) content and uptake of variety HUBR 2-1 proved significantly superior to NDR-359 during both the years due to varietal differences and recorded maximum zinc and iron in grains than HUBR 2-1. Since this variety is aromatic in nature which supported the established fact that zinc and iron concentration in grains are related to aromaticity of the variety. These findings are strongly supported by Graham *et al.* (1997), Qui *et al*. (1993) and Babu *et al.* (2005).

Table 1. Effect of Zn, Fe and FYM on yield attributes and yield of rice (pooled data).

Treatments	Yield attributes and economics							
	Panicle m^{-2} (No.)	Grains/ panicle	Test wt. (g)	Grain yield (qha^{-1})	Straw yield (qha^{-1})	Cost of cultivation (Rs/ha)	Net returns (Rs/ha)	Benefit: Cost ratio
Varieties								
V_1: NDR – 359	385.99	124.61	31.33	55.05	75.01	29202.48	31906.08	1.09
V_2: HUBR 2-1	365.39	140.15	20.05	48.75	72.34	29577.54	55312.55	1.87
SEm±	4.59	1.58	0.27	1.06	0.70	-	1244.75	0.05
CD (P = 0.05)	15.87	5.44	0.94	3.66	2.42	-	4307.35	0.15
Fertilizers								
F_1: 100% RFD through inorganics	361.19	128.51	25.47	49.75	71.96	28960.05	40922.15	1.41
F_2: 75% RFD through inorganics + 25% N through FYM	390.19	136.52	25.91	54.06	75.41	29819.97	46296.48	1.55

SEm±	4.59	1.58	0.27	1.06	0.70	-	1244.75	0.05
CD (P = 0.05)	15.87	5.44	0.94	3.66	2.42	-	4307.35	0.15
Micro-nutrient (Zn and Fe)								
M_0: Control	335.05	115.05	24.26	43.49	65.83	26744.01	34686.01	1.30
M_1: Zn-EDTA @ 1.00 kg ha^{-1} (S)	372.31	133.63	26.28	53.25	74.65	29635.76	45118.47	1.52
M_2: Zn-EDTA @ 0.5 kg ha^{-1} (F)	361.92	130.09	25.56	51.60	73.11	29295.76	43282.41	1.48
M_3: Fe-EDTA @ 1.00 kg ha^{-1} (S)	359.82	126.10	25.43	50.71	72.28	29635.76	41739.90	1.41
M_4: Fe-EDTA @ 0.5 kg ha^{-1} (F)	378.95	132.43	25.64	52.72	74.39	29295.76	44948.41	1.53
M_5: Zn-EDTA @ 1.00 kg ha^{-1} (S)+Fe-EDTA@1.00kg ha^{-1} (S)	387.41	135.33	25.66	52.85	74.92	30315.76	43966.06	1.45
M_6: Zn-EDTA @ 0.5 kg ha^{-1} (F) fb Fe-EDTA @ 0.5 kg ha^{-1} (F)	395.75	137.21	25.68	53.48	75.58	29635.76	45575.07	1.54
M_7: Zn-EDTA @ 1.00 kg ha^{-1} (S) fb Fe-EDTA @ 0.5 kg ha^{-1} (F)	407.78	146.87	26.25	56.27	78.52	29975.76	49120.43	1.64
M_8: Fe-EDTA @ 1.00 kgha^{-1}(S) fb Zn-EDTA @ 0.5 kg ha^{-1}(F)	382.21	135.73	26.80	52.76	74.77	29975.76	44047.08	1.47
SEm±	4.23	1.53	0.26	0.83	0.65	-	1187.41	0.04
CD (P = 0.05)	11.96	4.31	0.74	2.35	1.84	-	3354.65	0.11

***RFD –Recommended Fertilizers Dose, S – Soil application, F – Foliar application, fb – Followed by, NS – Non-significant**

Table 2. Effect of Zn, Fe and FYM on total uptaket of rice grain (pooled data).

Treatments	**Nutrient uptake (kg/ha)**				
Varieties	**N**	**P**	**K**	**Zn**	**Fe**
V_1: NDR – 359	121.38	29.22	167.61	2.44	1.55
V_2: HUBR 2-1	108.56	26.98	157.54	2.56	2.11
SEm±	1.80	0.44	0.51	0.02	0.01
CD (P = 0.05)	6.23	1.51	1.75	0.08	0.03
Fertilizers					
F_1: 100% RFD through inorganics	108.75	24.22	152.70	2.34	1.64
F_2: 75% RFD through inorganics + 25% N through FYM	121.20	31.97	172.45	2.66	2.02
SEm±	1.80	0.44	0.51	0.02	0.01
CD (P = 0.05)	6.23	1.51	1.75	0.08	0.03
Micro-nutrient (Zn and Fe)					
M_0: Control	91.48	20.36	134.92	1.77	1.18
M_1: Zn-EDTA @ 1.00 kg ha^{-1} (S)	117.94	29.31	167.47	2.80	1.67
M_2: Zn-EDTA @ 0.5 kg ha^{-1} (F)	109.84	27.09	156.56	2.55	1.54
M_3: Fe-EDTA @ 1.00 kg ha^{-1} (S)	107.29	25.96	153.15	2.35	1.82
M_4: Fe-EDTA @ 0.5 kg ha^{-1} (F)	116.88	28.53	164.23	2.36	2.32

M_5: Zn-EDTA @ 1.00 kg ha^{-1} (S)+Fe-EDTA@1.00kg ha^{-1} (S)	118.72	28.92	167.86	2.64	1.81
M_6: Zn-EDTA @ 0.5 kg ha^{-1} (F) fb Fe-EDTA @ 0.5 kg ha^{-1} (F)	124.26	31.00	173.14	2.72	2.07
M_7: Zn-EDTA @ 1.00 kg ha^{-1} (S) fb Fe-EDTA @ 0.5 kg ha^{-1} (F)	131.71	33.00	180.93	2.85	2.16
M_8: Fe-EDTA @ 1.00 kgha^{-1}(S) fb Zn-EDTA @ 0.5 kg $ha^{-1(}$F)	116.62	28.72	164.92	2.48	1.89
SEm±	1.44	0.34	0.37	0.02	0.01
CD (P = 0.05)	4.08	0.94	1.05	0.05	0.02

***RFD –Recommended Fertilizers Dose, S – Soil application, F – Foliar application, fb – Followed by, NS – Non-significant**

Regarding source of fertilizer treatment 75% RFD through inorganic sources + 25% N through FYM proved superior over 100% RFD through inorganics in increasing NPK content and uptake during both the years. Nitrogen content in plant at flowering stage and in grain though increased due to 75% RDF through inorganics + 25% N through FYM over 100% RFD through inorganics but failed to touch the level of significance. However it proved significantly superior in respect of N content in straw, P and K content of plant at flowering stage and in grain and straw over 100% RFD during both the years. Application of 75% RFD + 25% N through FYM also remained significantly better over 100% RFD in respect of uptake of N, P and K in grain and straw. The present results are in agreement with the findings of various workers (Srivastava *et al*.(2008) and Chandrapala *et al.* (2010). Application of organic manures along with macro and micronutrients might have enriched the soil fertility due to increased micronutrient availability due to formation of plant available organic-metal complexes with decomposition of organic materials and thus brought about variations in the grain yield of cereal crops through direct influence on the yield attributes and grain yield. Increase in nutrient uptake with the increase in fertility levels could be attributed to the better availability of nutrients and their transport to the plant from the soil, which enhanced the uptake of nutrients by plant. Similar results have also been reported by Singh *et al*. (2002) and Kumar and Kumar (2009). Micro-nutrient (Zn and Fe) content and uptake significantly increased due to 75% RFD through inorganics + 25% N through FYM over 100% RFD through inorganics at flowering stage and in grain and straw during both years. Highest Zn content and uptake was recorded under treatment receiving 10 tonne organic manure+5 kg Zn ha^{-1} by Pandey *et al*, (2007), Sridevi *et al.* (2010) and Satish *et al*.,(2010). Use of organic manure with the optimum level of zinc reduced its requirement upto 50%. Beneficial effect of organic manures may be attributed to the formation of organometallic complexes with zinc, which resulted in the increase of its efficiency. These results are in accordance with findings of several workers Gupta and Handore (2009). Organic sources also improved the content of Fe by supplying chelating agents, which helps in maintaining the solubility of micro-nutrients including Fe. In addition, organic matter improves soil structure which provides better soil aeration resulting into increased availability of Fe. The response of organic matter showed profound influence on the solubility of Fe in waterlogged soil by providing resistance to Fe chlorosis visual indices, increasing foliar content of chlorophyll and which enabled to excrete reduced compounds from the roots (Singh *et al.*, 2010). Organic matter in the soil exerts a positive effect on solubility of Fe through its reductive effect out of proportion with the amount of Fe contained in the biomass. Adding organic matter to a soil deficient in available Fe exerts a positive effect on the plants. Biological degradation of the organic matter contributes negative electron and other reducing agents which lowers the redox potential of the soil, creating reducing microenvironments in the soil where the concentration of Fe (II) available to the plants increased. It is thus apparent that application and maintenance of organic matter in the soil translates adequate long term availability of Fe as has been observed in present investigation and are in agreement with the findings of various workers (Lindsay, 1991). Mishra *et al.* (2004) reported that application of organic manures to rice fields increased the Fe concentration and its uptake in rice and suggested that their regular addition is the best way to avoid Fe deficiency. Improving N nutrition of plants may contribute to increase Zn and Fe concentration in grain by affecting the levels of Zn or Fe-chelating nitrogenous compound, required for transport of Zn and Fe within plants which increased Zn and Fe transporters needed for its uptake by root and phloem loading. It indicates that nitrogen management is an effective agronomic tool to enhance grain Zn and Fe concentrations. The present results are in agreement with the findings of Ismail Cakmak[A] (2010).

Content and uptake of Zn and Fe in grains and straw markedly increased due to Zn and Fe application over control during both the years of investigation. Combined and sequential application of zinc and iron slightly decreased zinc and iron concentration in grains, when compared with their separate application. The results are in conformity with the findings of Hemantaranjan and Garg (1988), and Zhang *et al*. (1991) who reported that single application of these micro-nutrients improved their concentration in grains, but when applied simultaneously antagonized to each other. Incorporation of Zn-EDTA @ 1.00 kg ha^{-1} as soil application showed significant superiority over all treatments in increasing Zn content. Chandrapala *et al.* (2010) and Naik and Das (2008), reported increased uptake of Zn in grain and straw due to application of Zn-EDTA and concluded that the greater affectivity of Zn-EDTA over other sources of Zn in terms of growth and its utilization by plants which might be due to less retention greater transport and movement of chelated Zn to plant roots. Alvarez *et al.* (2001) reported that when Zn was added as Zn-EDTA, the amounts of the most labile fractions (water-soluble plus exchangeable and organically complexed Zn) increased throughout the entire soil profile column, which enhanced the root-cell membrane function. Activity of CA is closely related to zinc content in C_3 plants. Under extreme zinc deficiency, CA (carbonic anhydrase) activity remained almost absent. The labeled Zn rapidly accumulated in the roots of cereal crops upon immersion into the isotope solution. Root uptake and root-to-shoot transport of zinc and particularly internal utilization of zinc are equally important mechanism involved in the expression of zinc efficiency in cereal crops varieties (Pearson and Rengel, 1995). About Zn re-translocation little is known regarding its transport from roots to leaves and from leaves to other plant organs. Enhanced translocation of zinc from root to shoot meristems and its re-translocation from senescing to growing organs under deficient cereals is well known. The enhanced capacity of genotypes for zinc translocation from root to shoot and its utilization under deficient Zn supply has been shown to contribute to Zn deficiency in cereal genotypes. Cakmak *et al.* (1996) and Hajiboland *et al.* (2001) found that zinc deficiency tolerance of Zn- efficient rice genotypes is related to its ability to re-translocate zinc from older to growing emerging leaves. Incorporation of Fe and Zn-EDTA @ 0.5 kg ha^{-1} each as foliar application recorded their more concentration and uptake over other combinations. Similar results have been reported by Seilsepour. El-Ghamry *et al*. (2009) and Habib, (2009). Sperotto *et al.* (2010) reported that foliar application of Zn+Fe at tillering and heading stage increased Zn and Fe concentration and its uptake. Since flag leaves are one of the sources of remobilized metals for developing seeds, the identification of the molecular players that might contribute to the process of metal transport from flag leaves to the seeds may be useful for biofortification purposes in relation to Zn and Fe. However for Zn uptake application of Zn-EDTA @ 1.00 kg ha^{-1} as soil application followed by Fe-EDTA 0.5 kg ha^{-1} as foliar application at 15 DAT and at 50% panicle initiation proved significantly superior over all other treatments during both the years.The present results are in agreement with the findings of various workers Subrahmanyam and Mehata (1974) and Varshney *et al*. (2008).

Fe content and uptake significantly increased due to foliar application of Fe-EDTA @ 0.5 kg ha^{-1} at 15 DAT and at 50% panicle initiation (M_4) overall other treatments. Fe is shown to be transported from the root to areal plant organs in the xylem as a ferric citrate complex (Tiffin, 1966). Fe^{2+} is the main form absorbed by rice leaf and Fe^{3+} reduction is prerequisite for its absorption in grains. Fe accumulation trend in rice grains at grain filling stage of rice crop reflects that at anthesis Fe concentration in grains remains down from first 20 days after anthesis. Contrary to this Fe density in grains remains up, from first 20 days after anthesis but decreases thereafter. This suggests the speed of Fe accumulation in grains per unit time is lower markedly than down loads of the carbohydrate, but the content of Fe per grain certainly increased slowly. Generally, Fe concentration decreased initially even though their rate of accumulation was highest during this period. Fe accumulation and dry matter down load in rice grains are not synchronous which show the mechanism of Fe and the carbohydrate uptake by grains is different. Results thus indicated the use of Fe would be more effective when it applied 20 days after anthesis. These results were supported by Singh *et al.* (2002), Kulandaivel (2004). However, the spraying with micronutrients showed marked increase uptake as compared to other treatments. In plants utilizing strategy (I), chlorophytum under iron deficiency remains associated with rhizophere acidification, whereas considerable amounts of apoplasmic Fe in the roots are mobilized and translocated to the shoots (Bienfait *et al*.,1983). Accordingly, the translocation of Fe to the shoots increased steeply in Fe-deficient plants after onset of the light period and continued thereafter more or less continuously. This discrepancy between timing of phytosiderophore release and Fe translocation is probably the result of the experimental conditions. Additionally, the continuous translocation of Fe to the shoots during the light period could be derived from a pool formed within the roots after onset of the light period. The chemical nature of this Fe pool in roots is not known. It is also not clear whether Fe (III) phytosiderophores are involved in Fe translocation from roots to the shoot (Marschner, 1991).

Experimental evidence is lacking on a role of nicotianamine in long distance transport of Fe from

roots to the shoots. Microbial siderophores may maintain a continuous and substantial supply of soluble Fe to the root surface. Depending on their chelate stability, they make an important contribution to the apoplasmic Fe pool and thus the source of Fe readily mobilized by phytosiderophores in graminaceous species (Zhang *et al*., 1991). The similar result was found by Yassen *et al.* (2010). However, Fe content improved due to application of N through organic sources. Organic materials supply chealating agents, which helps in maintaining the solubility of micronutrients including Fe and Mn. In addition organic matter improves soil structure which provides better soil aeration resulting in to increase in the availability of Fe (Das *et al.*, 2010). The presence of organic matter showed a profound influence on the solubility of Fe in waterlogged soils. The uptake of zinc or iron was reduced in combined soil application as well as foliar of Zn and Fe but their uptake increased when applied to soil individually indicating antagonism between these two micronutrients.Chandrakumar *et a.l*(2004) also reported that application of these micronutrients improved their uptake in rice when applied separately, but when supplied simultaneously antagonized to each other.

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RESEARCH ARTICLE

SCREENING OF 110-R ROOT STOCK BASED TABLE VAREITIES OF GRAPE VINE (*VITIS VINIFERA* L.) AGAINST ANTHRACNOSE DISEASE CAUSED BY *ELSINOE AMPELINA* (DE BARY) SHER IN MANDSAUR DISTRICT OF MADHYA PRADESH

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Abstract: Grape is most important refreshing, commercial fruit crop and planted in temperate, subtropical and tropical agro-climatic condition. It is rich in sugar, vitamin, tannin and mineral like calcium, phosphorus and iron. 30 table varieties of grape viz Sharad Seedless, Krishna Seedless, Flame Seedless, A 18-3, Fantasy Seedless, Kishmish Moldowsky, Black Seedless , Kishmish Rozavis Red, Crimson Seedless , Ruby Seedless , Kishmish Chorni, Thompson Seedless, 2-A Clone, Superior Seedless, Manjri Naveen, Seedless Merbein, H-5, Sonaka, New Perlette, New Perlette, Sultanin-2, Pusa Seedless, Pusa Urvashi, Kishmish Rozavis White, Red Globe, Christmas Rose, Rizamat, Italia, Dilkhush, Muscat of Alexandria, Anabe-Shahi planted for table purpose in Horticulture research farm located at Krishi Nagar under RVSKVV, KNK College of Horticulture, Mandsaur M.P.,India. Intensity of anthracnose disease caused by *Elsonoe ampelina* on grape was recorded by 0-4 scale of visual rating in natural epiphytotic condition. The disease appeared during the first week of July 2018 (SMW-27) with disease intensity of 10.10% with the maximum temperature (32.27 °C), minimum temperature (22.58 ^{0}C), humidity (75.42%), and rainfall (26.25mm).It reached its peak at the second week of September (MSW-37) with maximum disease intensity of 60.26% with the maximum temperature (29.07 °C), minimum temperature (23.68 °C), humidity(89.71%), and rainfall (2.5mm).The higher disease severity during warm and wet weather was found. The disease intensity ranged between 10.10 to 60.26 per cent and cumulative disease intensity increased from July to September (SMW-27 to SMW -37). After categorization for disease intensity Fantasy Seedless (15.77%), Sultanin-2 (20.45%), Kishmish Rozavis White (25.80%) and Anabe-Shahi (24.66%) were recorded as moderately susceptible varieties. Sharad Seedless (42.00%), Krishna Seedless (40.50%), A 18-3 (34.34%), Flame Seedless (28.62%) and eleven varieties were treated as Susceptible. Further, Superior Seedless (60.00%), 2-A Clone (52.54%) and Manjri Naveen (51.76%) were considered as highly susceptible.

Keywords : *Vitis vinifera*, *Elsonoe ampelina*, Anthracnose

INTRODUCTION

Grape (*Vitis vinifera* L.) is one of most important commercial fruit crops, which is a good source of minerals like calcium,phosphorus ,iron and vitamins such as B1 and B2 (Radha and Mathew,2007). It is one of the most delicious, refreshing and nourishing fruit of the world and is classed as a protective food. In India commercially different varieties of grape are cultivated in the states of Maharastra, Karnataka, Tamil Nadu, Punjab, Haryana, Uttar Pradesh and on some scale in Rajasthan and Madhya Pradesh. In India, it is cultivated in an area about 64.4 000 hectares and production is 1677.1000 tone. In Madhya Pradesh grape is largely cultivated in Ratlam, Mandsaur, Indore, Ujjain, and Guna districts.

Various pathogens like bacteria, virus, nematodes and fungi, attack in grape vine. Fungal diseases are most destructive than bacterial, viral and nematode diseases. A number of disease have recorded in India on grapes including Anthranose (*Botryodiplodia palmarum,Elsinoe ampelina*), (Pathak, 1980). Anthracnose and powdery mildew (Mukherji and Bhasin, 1986) and downy mildew (Shahzad *et al.*, 2006) have been reported in Kashmir.

It is most important serious and destructive diseases after powdery and downy mildew and known as "Bird's eye spot". The annual loss due to anthracnose of grapes is estimated to be 15-30 per cent (Anonymous, 2006). The disease is most damaging in rainy season. The disease appears on all the green parts of grape like leaf, shoot, tendril, cane, fruits. The disease mostly affects new shoots and fruits of plants. Small, circular to irregular dark brown spots appear on leaves and central necrotic tissue often falls off leaving a shot-hole appearance. Small isolated light brown spots develop on shoots and tendrils. In severe cases this disease exhibits complete drying of leaves. On berries, bird's eye spot symptoms appear having violet to grayish center and dark brown margins (Jamdar, 2007).

MATERIALS AND METHODS

The present investigations were undertaken at Horticulture research farm located at Krishi Nagar under RVSKVV, KNK College of Horticulture, Mandsaur during *kharif* 2018. Observations were taken from last week of June to first week of September, 2018 under natural epiphytotic conditions on 30 table varieties of grape with rootstock of 110-R viz Sharad Seedless, Krishna Seedless, Flame Seedless, A 18-3, Fantasy Seedless , Kishmish Moldowsky, Black Seedless, Kishmish Rozavis Red, Crimson Seedless , Ruby Seedless ,

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Kishmish Chorni, Thompson Seedless, 2-A Clone, Superior Seedless, Manjri Naveen, Seedless Merbein, H-5, Sonaka, New Perlette, New Perlette , Sultanin-2, Pusa Seedless, Pusa Urvashi , Kishmish Rozavis White , Red Globe, Christmas Rose, Rizamat, Italia, Dilkhush, Muscat of Alexandria and Anabe-Shahi, were planted for table purpose. The symptoms of size, shape, colour of lesions on leaves, shoots, tendrils and berries was recorded. The disease intensity was recorded by visual observations using 0-4 scale (table-1) with slight modifications. The table varieties were categorized as, tolerant (0.1-5.0 %), moderately tolerant (5.1-10.0%), moderately susceptible (10.1-25.0%), susceptible (25.1-50.0% and highly susceptible (50.1% and above) as suggested by Chatta (1992).

Table 1. Disease intensity parameter for anthracnose on grape

Category	Numerical value	Description
I	0	Healthy foliage or leaf spots in traces
II	1	Up to 10 per cent leaf area covered with anthracnose lesions
III	2	10.1-25 per cent leaf area covered with slight twig infection i.e. 1-3 cankers per twig
IV	3	25.1-50 per cent leaf area covered with heavy twig infection i.e. 4-10 cankers per twig
V	4	Above 50 per cent leaf area covered with very heavy twig infection i.e. above 10 cankers per twig and heavy berry infection

Per cent disease intensity (PDI) was recorded by using formula given by Wheeler (1969):

$$PDI = \frac{\text{Sum of numerical values}}{\text{Total units observed x Maximum numerical value}} \times 100$$

Table 2. Categorization of table varities of grapes against anthracnose disease.

Reaction category	Per cent disease index
Tolerant	0.1-5.0
Moderately tolerant	5.1-10.0
Moderately susceptible	10.1-25.0
Highly susceptible	50.1 and above

Chatta (1992).

RESULT AND DISCUSSION

The anthracnose disease appeared in all the green parts of grape (Plate 1) but mostly affected new shoots and fruits. Small, numerous pin head like circular to irregular dark brown spots appeared on leaves in initial stage and later spread in overall surface of leaves and later central necrotic tissue fallen off leaving a shot-hole appearance. Small isolated and elongated light brown spots developed on shoots and tendrils and these spot slightly sunken and finally complete drying of leaves was observed. On berries, bird's eye spot symptoms appeared having violet to greyish centre and dark brown margins (Plate-1). The disease appeared during the first week of July 2018(SMW-27) with disease intensity of 10.10% (table 4 and fig. 1) with the maximum temperature (32.27 ^{0}C), minimum temperature (22.58 ^{0}C), humidity (75.42%), and rainfall (26.25mm). It reached its peak at the second week of September (MSW-37)) with maximum disease intensity of 60.26% with the maximum temperature (29.07 ^{0}C), minimum temperature (23.68 ^{0}C), humidity (89.71%), and rainfall (2.5mm). The higher disease severity during warm and wet weather found in present study, coincide with findings of Suhag and Grover (1979). High humidity and precipitation in monsoon resulted in maximum development of anthracnose (Suhag and Kaushik, 1982). The abundant production of conidia, their spread and more development of anthracnose in the vineyards depends upon frequent rains (Brook, 1973, Suhag and Grover, 1973). The disease intensity ranged between 10.10 to 60.26 per cent (table 4) and cumulative disease intensity increased from July up to September (MSW27-37). After categorization for disease intensity (table 2,3) Fantasy Seedless (15.77%), Sultanin-2 (20.45%), Kishmish Rozavis White (25.80%) and Anabe-Shahi (24.66%) were recorded as moderately susceptible varieties. Sharad Seedless (42.00%), Krishna Seedless (40.50%), A 18-3 (34.34%), Flame Seedless (28.62%) and eleven varieties were treated as Susceptible. Further, Superior Seedless (60.00%), 2-A Clone (52.54%) and Manjri Naveen (51.76%) were considered as highly susceptible. These results are in partial agreement with the findings of Thind et al. (1997) who evaluated grape cultivars Perlette, and other seedless varieties of which Perlette and Beauty Seedless were most susceptible while in present study Perlette grape cultivars have been found to be susceptible to *S. ampelina*. These findings are further

partially supported by Thind *et al.* (1998), Chandermohan *et al.* (2002), Thind and Nirmalijit (2005) who rated Anab-e-shahi, Perlette as highly susceptible cultivar. The cultivars with moderately tolerant to tolerant reaction can be used in hybridization program to evolve cultivars possessing desirable traits, besides resistance to anthracnose pathogen.

Table 3. Disease intensity of grape varieties against anthracnose disease caused by *Elsinoe ampelina* under natural epiphytotic conditions

S.No.	Varieties	Disease intensity (%)	S.No.	Varieties	Disease intensity (%)
1.	Sharad Seedless	42.00	16.	Seedless Merbein	51.76
2.	Krishna Seedless	40.5	17.	H-5	34.63
3.	Flame Seedless	28.62	18.	Sonaka	43.57
4.	A 18-3	34.34	19.	New Perlette	44.44
5.	Fantasy Seedless	15.77	20.	Sultanin-2	38.13
6.	Kishmish Moldowsky	30.24	21.	Pusa Seedless	20.45
7.	Black Seedless	29.09	22.	Pusa Urvashi	37.54
8.	Kishmish Rozavis Red	29.09	23.	Kishmish Rozavis White	33.88
9.	Crimson Seedless	48.14	24.	Red Globe	25.80
10.	Ruby Seedless	37.84	25.	Christmas Rose	26.25
11.	Kishmish Chorni	30.76	26.	Rizamat	29.18
12.	Thompson Seedless	49.74	27.	Italia	31.11
13.	2-A Clone	52.54	28.	Dilkhush	31.07
14.	Superior Seedless	60.00	29.	Muscat of Alexandria	35.2
15.	Manjri Naveen	51.76	30.	Anabe-Shahi	24.66

Table 4. Screened grape varieties against anthracnose disease caused by *Elsinoe ampelina* under natural epiphytotic conditions

S. No	Screening parameter	Varieties
1	**Moderately susceptible**	Fantasy Seedless, Sultanin-2, Kishmish Rozavis White and Anabe-Shahi
2	**Susceptible**	Sharad Seedless, Krishna Seedless, Flame Seedless, A 18-3, Kishmish Moldowsky, Black Seedless, Kishmish Rozavis Red, Crimson Seedless, Ruby Seedless, Kishmish Chorni, Thompson Seedless, Seedless Merbein, H-5, Sonaka, New Perlette,
3.	**Highly susceptible**	2-A Clone, Superior Seedless and Manjri Naveen

Table 5. Effect of weather parameters on the development of grape anthracnose disease

Time of observation			**Disease intensity %**	**Mean temperature**		**Humidity %**	**Rainfall mm**
Month	**Period**	**SMW**		**Maximum ˚C**	**Minimum**	**Maximum %**	

June 4rth	**24/6/2018-30/6/2018**	**26**	**0**	**28.82**	**27.35**	**77.57**	**30.35**
July 1st	**1/7/2018-7/7/2018**	**27**	**10.10**	**32.27**	**22.58**	**75.42**	**26.25**
2nd	**8/7/2018-14/7/2018**	**28**	**12.22**	**31.28**	**21.82**	**79.42**	**97.5**
3rd	**15/7/2018-21/7/2018**	**29**	**15.51**	**38.48**	**21.34**	**81.28**	**31**
4rth	**22/7/2018-28/7/2018/**	**30**	**16.11**	**27.1**	**21.8**	**83.14**	**19.4**
August 1st	**29/7/2018-4/8/2018**	**31**	**25.14**	**29.17**	**19.05**	**85.85**	**0**
2nd	**5/8/2018-11/8/2018**	**32**	**30.44**	**31.57**	**22.00**	**81.14**	**59.5**
3rd	**12/8/2018-18/8/2018**	**33**	**45.66**	**30.94**	**23.48**	**85.42**	**95.00**
4rth	**19/8/2018-25/8/2018**	**34**	**48.23**	**29.1**	**23.17**	**94**	**52.5**
September 1st	**26/8/2018-1/9/2018**	**35**	**50.86**	**28.87**	**23.9**	**92**	**45.00**
2nd	**2/9/2018-8/9/2018**	**36**	**60.26**	**29.07**	**23.68**	**89.71**	**2.5**
3rd	**9/9/2018-15/9/2018**	**37**	**61.52**	**29.8**	**22.5**	**95.5**	**49.7**

Figure: 1. Effect of weather parameters on the development of grape anthracnose disease

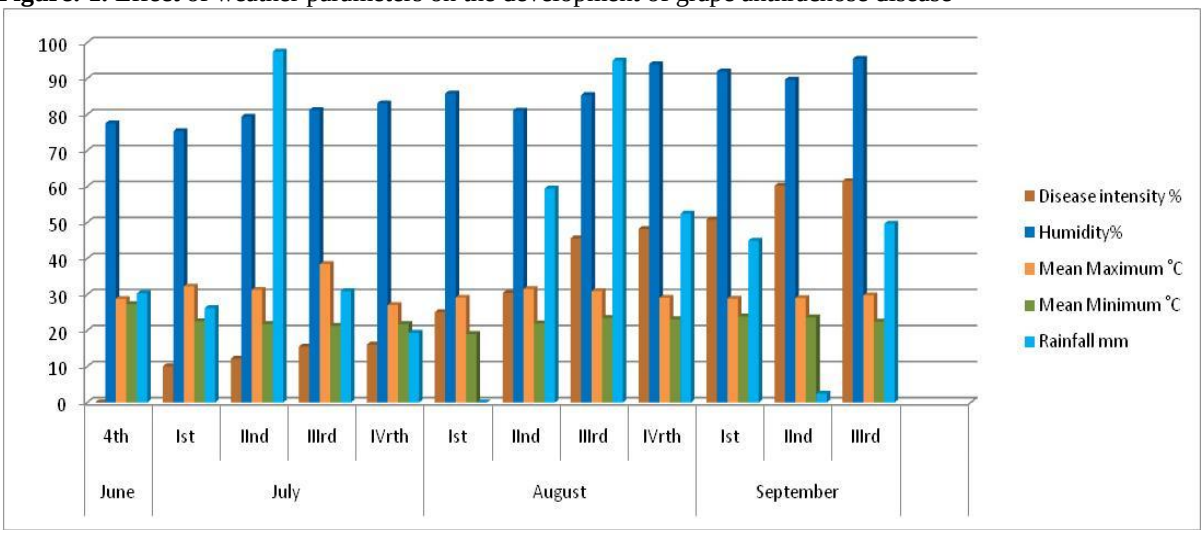

Plate-1

Severely infected grapevine yard

Healthy grapevine yard

Young shoot infection

Leaf infection

Twig infection

Berries/bunch infection

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RESEARCH ARTICLE

A STUDY ON FINANCIAL RATIO ANALYSIS OF SRI VENKATESWARA CO-OPERATIVE SUGAR LTD., RENIGUNTA, CHITTOOR DISTRICT.

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Abstract: Sugarcane is an important commercial crop cultivated in about 120 countries in the world. Sugarcane is cultivated in an area of 42.40million hectares in the world. The total area under sugarcane cultivation is highest in Brazil (6.20 million hectares) followed by India (5.01million hectare). Brazil is the biggest producer of sugar accounting for 41.4 per cent of the world sugarcane production followed by India (17.7 per cent).The secondary data was collected fromthe sugar factory records in the study area for the year of 2009-10 to 2013-14. The performance of sugar industry was examined by the financial indicators. The results revealed that, ratios for period of five years were found to be positive and some years are shown negative performance.The financial leverage of the factory over the study period reveals that financial risk of the firm showed an increasing trend. An interest and principal repayment component was taken and analysis was made from 2009-10 to 2013-14. For a rupee of capital employed in fixed assets and current assets by the company, the sales revenue generated by the company was highly fluctuating.

Keywords: Sugar factory, Financial indicators, Ratio analysis

INTRODUCTION

Sugarcane is an important commercial crop cultivated in about 120 countries in the world. Analysis of financial indicators are the Current ratio, current liabilities , Quick ratio, Debt ratio, Debt Equity Ratio, Interest Coverage Ratio, Fixed charges coverage ratio, Inventory Turnover ratio, Days of Inventory Holding, Fixed Assets Turnover Ratio Current Assets Turnover Ratio, Net Profit Margin, Gross Profit Margin, Operating Expenses Ratio, Cost of Goods Sold Ratio. Other Operating Expenses, Ratio, Return on Total Assets, Return on Net Assets, Return on Equity, fixed assets, current assets. Financial analysis is the process of identifying the financial strengths and weakness of the firm by properly establishing relationships between the items of balance sheet and profit and loss account. A more rigorous analysis of financial position of the factory was attempted by considering selected financial ratios and examining their trend over the selected years (2009-10 to 2013-14). For this purpose solvency, liquidity, profitability and turn over aspects of the factory were examined.

Objective of the study: To evaluate the growth and performance in terms of ratio analysis.

METHODOLOGY

The data used for the study, it was based on the secondary sources. The data on current liabilities, and total assets of sugar industry were collected fromSri Venkateswara co-operative sugar ltd, Gajulamandyam, Renigunta, Chittoor District, Andhra Pradeshfor the year 2009-10 to 2013-14.

Analytical tools

Financial indicators

To analysis of financial indicators are the current assets, current liabilities, fixed assets, current assets were employed.

RESULTS AND DISCUSSION

In this chapter an attempt is made to discuss the results obtain from the study. The important findings of this study are presented under following financial indicators. Table 1 represents the liabilities of the sugar factory in Sri Venkateswara co-operative sugar Ltd, Gajulamandyam, Renigunta.The balance sheet of the sugar factory for a period of five years that is from 2009-10 to 2013-14 was analyzed. Various parameters in the balance sheet were taken and ratio analysis was made for the same period and results were drawn.Current ratio and quick ratios of the sugar factory from 2009-10 to 2013-14 was calculated taking various parameters listed in the balance sheet.From the Table 1, it is inferred that the current ratios of the factory for the years 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 were 0.83, 0.73, 0.86, 0.84 and 0.73 respectively. This infers that the current obligations were higher compared to the current assets maintained by the company. From the Table 1, it is inferred that the quick ratio of the factory for the years 2009-10, 2010-11,2011-12,2012-13 and 2013-14 were 0.16 ,0.09,0.13,0.12 and 0.07 respectively.The quick ratios figures revealed that current assets other than inventory maintained by the company in the form of levy sugar, free sugarand molasses were quite negligible. Due to more payables and poor receivables inventory was lying ideal for more time. Hence the liquidity of

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the company was so not impressive from 2009-10 to 2013-14. Debt ratio and debt equity ratios of the sugar factory from 2009-10 to 2013-14 was calculated taking various parameters listed in the balance sheet. Form the Table 2, it is inferred that the debt ratio of the company for five years i.e. for 2009-10, 2010-11, 2011-12,2012-13 and 2013-14 were Rs. 0.44, Rs. 0.51, Rs. 0.57, Rs. 0.52 and Rs.0.59 respectively. The lenders contribution over the assets maintained by the company was increased from 2009-10 to 2011-12 and then decreased in the year 2012-13 and again increased in the year 2013-14.The debt ratio reveals that the lenders contribution has been on an increasing trend from 2009-10 to 2011-12 there by decreased marginally in 2012-13 and again shown an increasing trend in the year 2013-14. From the Table 2, it is inferred that the debt equity ratios for the years 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 were Rs. 0.81, 1.03, 1.37, 1.08, and 1.44 respectively. The debt equity ratio of the factory from 2009-10 to 2013-14 revealed that lenders contribution were more (or) less equal to owner's contribution. From the Table 3 it is inferred that the interest coverage ratios for the years 2009-10 and 2012-13 were 0.74 and 4.43 respectively.

From the Table 3, it is inferred that the Fixed charges coverage ratio for the year 2009-10 and 2012-13 were 0.05 and 0.19 respectively. For the remaining years i.e. for 2010-11, 2011-12 and 2013-14 the above two ratios were not calculated as there were no earnings available with the company in order to pay the interest principle.Inventory turnover ratio, Days of inventory holding, Fixed assets turnover ratio and current assets turnover ratio of the sugar factory from 2009-10 to 2013-14 was calculated taking various parameters listed in the balance sheet.

From the Table 3, it is inferred that the inventory turnover ratios of the factory for the years 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 were 3.04, 0.62, 1.10, 1.49 and 0.89 respectively. The days of inventory holding by the factory for the study period were 120, 575, 326, 241 and 404 respectively.From the Table 4, it is inferred that the inventory holding figures of the factory ranged from 120 to 575 days. This implied that factory did sales as per government regulations and open market price of sugar. Till that period the stock was stored in Godowns by the factory.From the Table 4, it is inferred that the fixed assets ratios and current assets ratios of the company for the years 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14. Similarly current asset ratio of the company for the year 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14. From the Table 5, gross profit margin, net profit margin, cost of goods sold ratio, other operating expenses, operating expenses and return on equity of the sugar factory from 2009-10 to 2013-14 was calculated taking various parameters listed in the balance sheet.From the table 4.10, it is inferred that the gross profit margins of the company for the year 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 were (0.092),(0.189), (0.0546), (0.772), and (0.044).

From the Table 5, it is inferred that the net profit margins of the company for the years 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 were 0.811, 2.311, 1.388, 1.0209, and 2.123. From the Table 5, it is inferred that the cost of goods sold ratio of the company for the years 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 were 0.907, 1.187, 1.054, 0.9025 and 1.046. From the Table 5, it is inferred that the other operating expenses ratio of the company for the year 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 was (0.049),(0.093),(0.040), (0.065),and (0.0571).

It is inferred from the profitability ratio that the factory was incurring losses over the study period i.e. from 2009-10 to 2013-14. The operating expenses of the company were also kept on the higher side. From the Table 5, it is inferred that the return on equity of the factory from 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 was (1.111), (1.32), (1.465), (1.307) and (1.729). The return on equity figures of the company reveals that there was no increase in the shareholders wealth from 2009-10 to 2013-14.

Table 1. Analysis of Liquidity Ratios

Financial Year	Current ratio	Quick ratio
2009-10	0.835	0.161
2010-11	0.732	0.093
2011-12	0.864	0.131
2012-13	0.841	0.126
2013-14	0.735	0.078

Table 2. Analysis of leverage ratios:

Year	Debt ratio	Debt equity ratio
2009-10	0.44	0.813
2010-11	0.51	1.036
2011-12	0.57	1.37
2012-13	0.52	1.086

2013-14	0.59	1.4402

The results of the same are presented below.

Table 3. Analysis of interest coverage ratio and fixed charge coverage ratios:

Years	Interest coverage ratio	Fixed charges coverage ratio
2009-10	0.74	0.05
2010-11	–	–
2011-12	–	–
2012-13	4.43	0.19
2013-14	–	–

Table 4. Analysis of activity ratio:

Years	Inventory turnover ratio	Days of inventory holding	Fixed assets turnover ratio	Current assets turnover ratio
2009-10	3.043	120	4.778	2.429
2010-11	0.626	575	1.939	0.545
2011-12	1.105	326	3.683	0.895
2012-13	1.496	241	4.479	1.293
2013-14	0.89	404	2.85	0.791

Table 5. Analysis of profitability ratios

Years	Gross profit margin	Net profit margin	Cost of goods sold ratio	Other operating expenses ratio	Operating expenses ratio	Return on equity
2009-10	(0.092)	(0.811)	0.907	0.049	0.957	(1.111)
2010-11	(0.189)	(2.377)	1.187	0.093	1.281	(1.32)
2011-12	(0.0546)	(1.388)	1.054	0.040	1.094	(1.465)
2012-13	(0.772)	(1.0209)	0.9025	0.065	0.967	(1.307)
2013-14	(0.044)	(2.123)	1.046	0.0571	1.103	(1.729)

( ): - Indicates loss

Table 6. Ratio analysis of sugar industry

S.NO	Years	2009-10	2010-11	2011-12	2012-13	2013-14
1	Current ratio	0.835	0.732 (-12.3)	0.864 (18.0)	0.841 (-2.6)	0.735 (-12.6)
2	Quick ratio	0.161	0.093 (-42.2)	0.131 (29.0)	0.126 (-3.9)	0.078 (-38.0)
3	Debt ratio	-2.091	-12.076 (-9.9)	13.55 (12.2)	2.815 (79.2)	5.042 (79.1)

4	Debt Equity Ratio	0.813	1.036	1.37	1.086	1.4402
5	Interest Coverage Ratio	0.723	-2.187 (-402)	-0.782 (-135)	4.41 (463)	-33.56 (-113)
6	Fixed charges coverage ratio	0.051	-0.202 (-496)	-0.054 (-126)	0.195 (261)	-0.656 (-436)
7	Inventory Turnover ratio	0.043	0.626 (13.5)	1.105 (76.5)	1.496 (35.3)	0.89 (-40.5)
8	Days of Inventory Holding	120	574.8 (379)	325.6 (-43.3)	240.55 (-26.1)	404.28 (68.0)
11	Fixed Assets Turnover Ratio	4.778	1.939	3.683	4.479	2.85
12	Current Assets Turnover Ratio	2.429	0.545	0.895	1.293	0.791
13	Gross Profit Margin	0.092	-0.189	-0.0546	0.772	-0.044
14	Net Profit Margin	-0.811	-2.377	-1.388	-1.0209	-2.123
15	Operating Expenses Ratio	0.957	1.281	1.094	0.967	1.103
16	Cost of Goods Sold Ratio	0.907	1.187	1.054	0.9025	1.046
17	Other Operating Expenses Ratio	0.050	0.094	0.04	0.065	0.057
18	Return on Total Assets	0.029	-0.052	0.02	0.119	-0.024
	Return on Net Assets	0.356	1.688	0.608	0.695	0.94
19	Return on Equity	-1.111	-1.32	-1.465	1.307	-1.729

SUMMARY AND CONCLUSION

Sugarcane is an annual crop sown in the month of April to May and crop comes to harvesting between October to February and yields on an average 50 tonnes per hectare which yielded 35mertic tonnes per hectare. This indicates that the raw material supplied to the factory is only for a period of 3 to 4 months and hence the inventory turnover is done only was that period. Due to more payables and poor receivables inventory was lying ideal for more time. Hence the liquidity of the company was so not impressive from 2009-10 to 2013-14. Debt ratio and debt equity ratios of the sugar factory from 2009-10 to 2013-14 was calculated taking various parameters listed in the balance sheet. The financial leverage of the factory over the study period reveals that financial risk of the firm showed an increasing trend.An interest and principal repayment component was taken and analysis was made from 2009-10 to 2013-14. For a rupee of capital employed in fixed assets and current assets by the company, the sales revenue generated by the company was highly fluctuating.

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RESEARCH ARTICLE

REACTION OF BT COTTON HYBRIDS AGAINST SUCKING INSECT PESTS IN MALWA REGION OF MADHYA PRADESH

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Abstract: The experiment was undertaken on medium black cotton soil in *Kharif* season of 2015 at College of Agriculture Farm, Indore in randomized block design with nine selected cotton hybrids in three replications with the plot size of 3 x 3 m and plant to plant spacing of 0.6 x 0.6 m. Hybrids were sown on July 1, 2015. These hybrids were ACH-1BG –II, ACH-104-2 BG-II, ACH-152-2BG–II, ACH-115-2BG-II, ACH-1133-2BG-II, ACH-1199-2BG-II, RCH- 2 BG-II (standard check), ACHB-90-1BG-II and MRC-7918 BG-II (standard check). The population of aphid, jassid, thrips and whitefly, were recorded at 20, 30, 40, 50, 60, 70, 80, 90, 100, and 110 days after germination (DAG) on 5 observational tagged plants from two lower, two middle and two upper leaves per plants. The cotton yield was recorded on whole plot basis and converted into kg per hectare. All the received data were analysed statistically. On the basis of overall mean of all the intervals the minimum jassid population was noted in ACH-1199-2BG-II (5.85**)** and found at par with standard Check MRC-7918 BG-II (6.29). The continuous increasing trend from first to last observation was observed for whitefly, aphid and thrips. The mean whitefly population was recorded least in ACH-1199-2BG-II (8.04) and found at par with standard check MRC-7918BBG-I**I** (8.51) and standard check RCH-2BGII (8.53). In relation to aphid, standard check RCH-2BG-II (17.57) showed minimum population and found at par with ACH-1199-2BG-II (17.83). The least thrips population was noted in ACH-1199-2BG-II (15.17) and found to be at par with standard check MRC-7918BBG-II (15.93), ACH1133-2BG-II (16.01) and standard check RCH-2BG-II (16.37). The Highest seed cotton yield was observed in ACH-1155-2BG- II (2669kg/ha) and showed no significant difference with ACH-1199-2BG-II (2602 kg/ha), ACH-152-2BG-II (2262 kg/ha) and other hybrids.

Keywords: Bt cotton, Hybrids, Aphid, Leafhopper, Thrips, Whitefly, Reaction

INTRODUCTION

Cotton (*Gossypium hirsutum)* the white gold is an important *kharif* cash and fibre crop of India that exerts considerable influence in Indian economy. India is the second largest producer of cotton in the world after China accounting for about 18 per cent of the world cotton production. In India, area under cotton is 118.81 lakh ha along with production of 352 lakh bales and productivity of 503 kg lint ha^{-1}. In M.P. it is cultivated in 5.47 lakh ha area with total production of 17.0 lakh bales along with the productivity of 559 kg lint ha^{-1}**.**

The pest spectrum of the crop is quite complex and about 162 insect pests have been reported in India on this crop from the time of sowing till harvest (Anonymous, 2002)**.** The insect pests cause 56-60% reduction in yield**.** Important insect pests of cotton crop are sucking pests and bollworm complex. Among the sucking pests, aphid (*Aphis gossypii* Glover), leafhopper (*Amrasca biguttula* Ishida), thrips (*Scirtothrips dorsali* Hood), and whitefly (*Bemisia tabaci* Gennedius) attack in the early stage of the crop, while, bollworms viz. spotted bollworm (*Earias vittela* Fabricius and *Earias insulana* Boisduval), American bollworm (*Helicoverpa armigera* Hubner) and pink bollworm (*Pectinophora gossyiella* Saunders) are the most serious pests during the fruiting stage of the crop. Thus, the major problem in getting maximum production per unit area is due to the infestation of various insect pests, particularly bollworms of cotton. Bt-cotton currently occupies over 93% of the area under cotton cultivation. Genetic makeup of the plant is very much important to confer tolerance to biotic and abiotic stress under natural conditions. In India, introduction of Bt cotton involving several hybrids, most of which were highly susceptible to sucking pests has resulted in increased crop damage (Nagrare *et al*, 2014). The final evalution report of the Central Institute for Cotter Research (CICR) showed that Bt cotton varities developed by Monsanto and marketed by Mahyco, were susceptible to jassids, aphids and other sucking pests and several crop diseases. Bollgard II cotton having Cry1Ac and Cry2Ab protein showing toxicity against lepidopterous insect pests (Anonymous, 2002). In such sconditions the load of sucking insect pests also increased. Viewing the situation the experiment was planned to assess the performance of some selected Bt cotton hybrids (Bollgard II) against sucking insect pests.

MATERIALS AND METHODS

The experiment was carried out on medium black cotton soil in *Kharif* season of 2015 at College of Agriculture Farm, Indore in randomized block design with nine selected hybrids in three replications with the plot size of 3 x 3 m and plant to plant spacing of 0.6 x 0.6 m. Hybrids were sown on July 1, 2015. These hybrids were T1 ACH-1 BG –II, T2- ACH-104-2 BG-II, T3- ACH-152-2 BG –II, T4- ACH-

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1152 BG-II, T5- ACH-1133-2 BG-II, T6- ACH-1199-2 BG-II, T7- RCH- 2 BG-II (CHECK), T8- ACHB- 901 BG-II(HYB) and T9- MRC-7918 BG-II(HYB)(CHECK. The population of all the sucking pests like aphid, jassid, thrips and whitefly, were recorded at the successive crop growth stages *viz.* 20, 30, 40, 50, 60, 70, 80, 90, 100, and 110 days after germination (DAG) of the cotton on 5 observational tagged plants from two lower, two middle and two upper leaves per plants. The cotton yield was recorded on whole plot basis and converted into kg per hectare. All the received data were analysed statistically.

RESULS AND DISCUSSION

Sucking insect pests population

During the experimentation the jassid population (table 1) ranged from 3.53 (20 DAG- Days after Germination) to 14.07/leaf (90 DAG) with continuous increasing trend and later declined up to 4.27 at 110 DAG in all the hybrids. In 20, 50 and 80 DAG all the hybrids exhibited non significant variation and in remaining intervals, hybrid ACH-1BG-II showed significantly highest insect population followed by ACH-104-2BG-II. The least jassid number was recorded in ACH-1199-2BG-II at 40, 60, 70 and 90 DAG. On the basis of overall mean of all the intervals the minimum insect population was noted in ACH-1199-2BG-II (5.85) and found at par with standard Check MRC-7918 BG-II (6.29). The continuous increasing trend from first to last observation was observed for whitefly, aphid and thrips. Whitefly population ranged from 4.47 to 23.27/leaf (table 2) during all the intervals. In 20, 30 and 70 DAG all the hybrids exhibited non significant variation in whitefly population. Hybrids ACH-1BG-II and ACH-152-2BG-II expressed significantly highest population. ACH-1199-2BG-II showed least insect number in maximum intervals but was at par with rest of the hybrids. The mean whitefly population was recorded least in ACH-1199-2BG-II (8.04) and found at par with standard check MRC-7918BBG-II (8.51), standard check RCH-2BGII (8.53), ACH-104-2BG-II (9.08), ACH-1133--2BG-II (9.29) and ACH-115-2BG-II (9.87). Aphid population was recorded in the range of 3.87 to 41.00/leaf during all the observations (table 3). The non significant variation was noted in hybrids at 20, 40, 60 and 90 DAG. Hybrid ACH-1BG-II again showed poor performance with significantly highest aphid population in maximum intervals. From the overall mean it was revealed that standard check RCH-2BG-II (17.57) showed minimum aphid population and found at par with ACH-1199-2BG-II (17.83), ACH-1BG-II, ACH1133-2BG-II (18.12) and standard check MRC-7918BBG-II (18.77). The non significant variation in thrips population (table 4) was recorded at 20, 40 and 80 DAG in tested hybrids. Maximum thrips population with significant difference was observed in ACH-1BG-II (19.63) and ACH-104-2BG-II (18.24). Rest of the hybrids expressed lesser insect population with non significant variation. Based on the mean values the least population was noted in ACH-1199-2BG-II (15.17) and found to be at par with standard check MRC-7918BBG-II (15.93), ACH1133-2BG-II (16.01) and standard check RCH-2BG-II (16.37). The genetic resistance is the most outstanding and the cheapest technique in crop plants to control insects. The genetic resistance offers a capability of various cotton genotypes to provide an elevated production of superior prominence than susceptible varieties under same environmental conditions at the similar initial intensity of insects' incidence. In present study some recent *Bt* cotton hybrids have been tested which were not tested by earlier workers against the sucking pests which exhibited the presence of sucking pests but the findings of previous workers may support to present study in relation to the best performance of *Bt* cotton hybrids in reducing the sucking pest population and increasing the cotton yield. Vennila *et al.* (2004) stated that 134 *Bt* indicated tolerance response to jassids and white flies 138*Bt* had shown better tolerance to thrips and white flies and susceptible reaction of 144*Bt* to jassids, thrips and white flies were obvious. Saif-ur-Rehman *et. al.* (2013) and Sarwar *et. al.* (2013) explained that in general *Bt* cotton showed equal or higher sucking pest population than non *Bt* cotton verities. Mohapatra and Nayak (2014) reported that Sudarshan BGII was found highly susceptible to jassid, harbouring a maximum population of 4.95/leaf and closely followed by NCS 859 BGII (4.60/leaf), PRCH-331 BGII (4.56/leaf) and KDCHH 541 BG II (3.72/leaf). Muchhadiya *et al*. (2014) observed that jassid, white fly, thrips, and aphid were found damaging the *Bt* cotton throughout the season. Phulse and Udikeri (2014) reported the highest incidence of thrips, leafhoppers and whiteflies on MRC 7918 BG-II (17.3, 5.7 and 0.31/3 leaves respectively) followed by MRC 6918 non-*Bt*, RCH-2 BG-II and RCH-2 non *Bt*. Similar findings were also reported by Babu and Meghwal (2014) against thrips. The higher presence of sucking pest population might be due to less interspecific competition among sucking pests as *Bt* cotton hybrids are found resistant against bollworm complex.

Table 1. Jassid population in cotton hybrids during 2015-16

S.No	Hybrids	20 DAG	30 DAG	40 DAG	50 DAG	60 DAG	70 DAG	80 DAG	90 DAG	100 DAG	110 DAG	Over all mean
T1	ACH-1BG-II	5.13 (2.37)	6.13 (2.57)	7.07 (2.75)	8.07 (2.92)	8.80 (3.05)	9.67 (3.18)	11.50 (3.46)	14.07 (3.81)	6.13 (2.57)	6.40 (2.63)	8.12 (2.94)
T2	ACH-104-2BG-II	4.20 (2.16)	5.20 (2.38)	5.53 (2.45)	6.73 (2.68)	7.47 (2.82)	8.47 (2.99)	9.33 (3.13)	11.33 (3.43)	5.20 (2.38)	5.40 (2.43)	7.04 (2.75)
T3	ACH-152-2BG-II	4.87 (2.32)	6.00 (2.55)	6.33 (2.61)	7.13 (2.76)	8.20 (2.95)	9.27 (3.12)	10.33 (3.28)	12.17 (3.56)	6.00 (2.55)	6.20 (2.59)	7.79 (2.88)
T4	ACH-1152BG-II	3.87 (2.09)	4.60 (2.25)	5.47 (2.44)	6.53 (2.64)	8.40 (2.98)	8.33 (2.97)	8.60 (3.02)	11.10 (3.40)	4.60 (2.25)	4.60 (2.25)	6.82 (2.71)
T5	ACH-1133-2BG-II	4.13 (2.15)	4.93 (2.33)	5.67 (2.48)	6.80 (2.70)	7.53 (2.83)	8.60 (3.02)	9.43 (3.15)	10.67 (3.34)	4.93 (2.33)	4.33 (2.19)	6.73 (2.69)
T6	ACH1199-2BG-II	3.53 (2.00)	4.53 (2.24)	5.07 (2.35)	5.47 (2.44)	6.33 (2.61)	7.07 (2.74)	7.80 (2.86)	9.00 (3.08)	4.53 (2.24)	4.67 (2.27)	5.85 (2.52)
T7	RCH-2BG-II(CHECK)	3.93 (2.10)	4.87 (2.32)	5.40 (2.43)	6.40 (2.62)	7.40 (2.81)	7.67 (2.85)	8.33 (2.97)	10.83 (3.36)	4.87 (2.32)	4.27 (2.17)	6.46 (2.64)
T8	ACHB-901BG-II(HYB)	4.33 (2.20)	5.40 (2.43)	5.40 (2.42)	6.33 (2.61)	7.20 (2.77)	7.93 (2.90)	8.47 (2.99)	11.00 (3.39)	5.40 (2.43)	5.93 (2.53)	7.02 (2.74)
T9	MRC-7918BG-II (CHECK)	3.60 (2.02)	4.47 (2.22)	5.20 (2.38)	6.04 (2.56)	7.00 (2.74)	7.53 (2.83)	8.03 (2.92)	9.33 (3.13)	4.47 (2.22)	5.33 (2.41)	6.29 (2.61)
	SEm ±	NS	0.08	0.09	NS	0.09	0.09	NS	0.12	0.08	0.11	0.03
	CD at 5 %	NS	0.25	0.27	NS	0.28	0.28	NS	0.38	0.25	0.34	0.09
	CV %	-	5.81	6.02	-	5.38	5.17	-	6.18	5.81	7.92	1.86

Values in parentheses are square root transformed values $\left(\sqrt{x+0.5}\right)$

Table 2. Whitefly population of in cotton hybrids during 2015-16

S. No	Hybrids	20 DAG	30 DAG	40 DAG	50 DAG	60 DAG	70 DAG	80 DAG	90 DAG	100 DAG	110 DAG	Over all mean
T1	ACH-1BG-II	6.13 (2.57)	5.13 (2.37)	6.73 (2.69)	5.87 (2.52)	10.33 (3.29)	13.47 (3.74)	16.93 (4.17)	19.47 (4.47)	21.37 (4.68)	23.27 (4.87)	12.79 (3.65)
T2	ACH-104-2BG-II	5.20 (2.38)	4.20 (2.16)	5.47 (2.44)	5.40 (2.43)	7.73 (2.86)	9.80 (3.21)	11.60 (3.46)	12.83 (3.64)	13.77 (3.77)	14.83 (3.90)	9.08 (3.09)
T3	ACH-152-2BG-II	6.00 (2.55)	4.87 (2.32)	6.53 (2.65)	5.73 (2.49)	9.77 (3.20)	12.90 (3.66)	16.47 (4.12)	18.27 (4.33)	21.27 (4.66)	22.90 (4.84)	12.40 (3.59)
T4	ACH-1152BG-II	4.60 (2.25)	3.87 (2.09)	4.73 (2.28)	4.47 (2.22)	8.53 (3.00)	11.37 (3.44)	12.57 (3.60)	14.17 (3.83)	16.03 (4.06)	18.33 (4.34)	9.87 (3.22)
T5	ACH-1133-2BG-II	4.93 (2.33)	4.13 (2.15)	5.27 (2.40)	4.60 (2.25)	8.47 (2.99)	10.20 (3.27)	11.63 (3.47)	13.10 (3.68)	14.20 (3.83)	16.33 (4.10)	9.29 (3.13)
T6	ACH1199-2BG-II	4.53 (2.24)	3.53 (2.00)	5.33 (2.41)	4.67 (2.27)	6.23 (2.59)	8.43 (2.99)	9.67 (3.18)	11.33 (3.41)	12.17 (3.55)	13.73 (3.77)	8. 04 (2.92)
T7	RCH-2BG-II (CHECK)	4.87 (2.32)	3.93 (2.10)	5.07 (2.36)	4.67 (2.27)	7.17 (2.77)	9.33 (3.13)	11.00 (3.39)	12.27 (3.57)	13.10 (3.68)	14.37 (3.85)	8.53 (3.01)
T8	ACHB-901BG-II(HYB)	5.40 (2.43)	4.33 (2.20)	5.60 (2.47)	4.87 (2.31)	8.83 (3.05)	12.30 (3.56)	14.17 (3.83)	16.13 (4.08)	18.03 (4.30)	20.60 (4.59)	11.03 (3.39)
T9	MRC-7918BG-II (CHECK)	4.47 (2.22)	3.60 (2.02)	5.33 (2.41)	4.73 (2.29)	7.37 (2.80)	9.10 (3.05)	10.93 (3.31)	11.50 (3.39)	12.57 (3.50)	14.33 (3.73)	8.51 (2.97)
	SEm ±	NS	NS	0.06	0.06	0.11	NS	0.19	0.22	0.22	0.23	0.10
	CD at 5 %	NS	NS	0.20	0.19	0.36	NS	0.61	0.68	0.71	0.71	0.33
	CV %	-	-	4.54	4.56	6.63	-	9.21	9.80	9.72	11.29	5.58

Values in parentheses are square root transformed values $\left(\sqrt{x+0.5}\right)$

Table 3. Aphid population in cotton hybrids during 2015-16

S. No.	Hybrids	20 DAG	30 DAG	40 DAG	50 DAG	60 DAG	70 DAG	80 DAG	90 DAG	100 DAG	110 DAG	Over all mean
T1	ACH-1BG-II	5.80 (2.50)	11.23 (3.42)	13.10 (3.69)	19.47 (4.47)	13.77 (3.77)	20.67 4.59	27.37 (5.26)	32.67 (5.75)	33.17 5.80	41.00 (6.44)	21.53 (4.69)
T2	ACH-104-2BG-II	4.80 (2.30)	7.17 (2.75)	11.03 (3.40)	12.83 (3.64)	21.27 (4.66)	17.50 4.24	22.17 (4.76)	27.10 (5.25)	36.67 6.09	35.13 (5.97)	19.18 (4.44)
T3	ACH-152-2BG-II	5.20 (2.39)	10.70 (3.35)	13.57 (3.75)	18.27 (4.33)	16.03 (4.06)	24.37 4.98	24.27 (4.98)	29.00 (5.42)	31.30 5.64	38.20 (6.21)	19.18 (4.44)
T4	ACH-115-2BG-II	4.33 (2.20)	7.07 (2.75)	10.10 (3.25)	14.17 (3.83)	14.20 (3.83)	19.67 4.48	19.83 (4.51)	24.67 (5.01)	34.30 5.90	33.80 (5.85)	20.93 (4.63)
T5	ACH-1133-2BG-II	4.87 (2.31)	7.63 (2.83)	11.50 (3.45)	13.10 (3.68)	12.17 (3.55)	19.17 4.43	20.47 (4.58)	25.77 (5.12)	28.33 5.37	34.73 (5.93)	18.12 (4.32)
T6	ACH1199-2BG-II	3.87 (2.09)	6.53 (2.62)	9.33 (3.13)	11.33 (3.41)	13.10 (3.68)	15.90 4.04	25.30 (5.06)	29.33 (5.46)	29.33 5.46	39.13 (6.29)	17.83 (4.28)
T7	RCH-2BG-II (CHECK)	4.27 (2.18)	6.67 (2.68)	9.67 (3.19)	12.27 (3.57)	18.03 (4.30)	16.10 4.06	20.17 (4.54)	25.17 (5.05)	34.67 5.92	34.07 (5.87)	17.57 (4.25)
T8	ACHB-90-1BG-II	5.03 (2.35)	7.10 (2.75)	10.40 (3.29)	16.13 (4.08)	12.57 (3.50)	21.03 4.63	23.10 (4.86)	27.33 (5.27)	28.83 5.41	36.73 (6.09)	18.00 (4.30)
T9	MRC-7918BG-II (CHECK)	4.03 (2.13)	6.57 (2.65)	9.43 (3.13)	11.50 (3.39)	13.30 (3.71)	22.50 4.77	27.03 (5.24)	31.17 (5.62)	32.67 5.75	40.70 (6.42)	18.77 (4.39)
	SEm ±	NS	0.16	NS	0.22	NS	0.22	0.17	NS	0.16	0.18	0.05
	CD at 5 %	NS	0.51	NS	0.68	NS	0.70	0.55	NS	0.50	0.57	0.17
	CV %	-	9.73	-	9.80	-	8.55	6.19	-	4.79	5.11	2.12

Values in parentheses are square root transformed values $\left(\sqrt{x+0.5}\right)$

Table 4. Thrips population in cotton hybrids during 2015-16

S. No	Hybrids	20 DAG	30 DAG	40 DAG	50 DAG	60 DAG	70 DAG	80 DAG	90 DAG	100 DAG	110 DAG	Over all mean	Cotton yield
T1	ACH-1BG-II	6.00 (2.54)	5.20 (2.39)	9.80 (3.21)	12.83 (3.64)	21.37 (4.68)	25.10 (5.05)	28.73 (5.40)	28.17 (5.35)	33.17 (5.80)	37.33 (6.15)	19.63 (4.49)	1045
T2	ACH-104-2BG-II	5.60 (2.46)	4.33 (2.20)	12.90 (3.66)	18.27 (4.33)	13.77 (3.77)	17.50 (4.24)	23.67 (4.92)	32.67 (5.75)	36.67 (6.09)	43.33 (6.62)	18.24 (4.33)	1463
T3	ACH-152-2BG-II	5.40 (2.43)	4.87 (2.31)	11.37 (3.44)	14.17 (3.83)	21.27 (4.66)	24.37 (4.98)	27.37 (5.26)	27.10 (5.25)	31.30 (5.64)	35.13 (5.97)	18.76 (4.39)	2262
T4	ACH-1152BG-II	4.27 (2.18)	3.87 (2.09)	10.20 (3.27)	13.10 (3.68)	16.03 (4.06)	19.67 (4.48)	22.17 (4.76)	29.00 (5.42)	34.30 (5.90)	38.20 (6.21)	17.13 (4.20)	2108
T5	ACH-1133-2BG-II	5.00 (2.34)	4.27 (2.18)	8.43 (2.99)	11.33 (3.41)	14.20 (3.83)	19.17 (4.43)	24.27 (4.98)	24.67 (5.01)	28.33 (5.37)	33.80 (5.85)	16.01 (4.06)	2022
T6	ACH1199-2BG-II	4.20 (2.15)	5.03 (2.35)	9.33 (3.13)	12.27 (3.57)	12.17 (3.55)	15.90 (4.04)	19.83 (4.51)	25.77 (5.12)	29.33 (5.46)	34.73 (5.93)	15.17 (3.96)	2699
T7	RCH-2BG-II(CHECK)	4.47 (2.22)	4.03 (2.13)	12.30 (3.56)	16.13 (4.08)	13.10 (3.68)	16.10 (4.06)	20.47 (4.58)	29.33 (5.46)	34.67 (5.92)	39.13 (6.29)	16.37 (4.10)	1795
T8	ACHB-901BG-II(HYB)	4.33 (2.20)	7.30 (2.79)	9.10 (3.05)	11.50 (3.39)	18.03 (4.30)	21.03 (4.63)	25.30 (5.06)	25.17 (5.05)	28.83 (5.41)	34.07 (5.87)	17.24 (4.21)	1738
T9	MRC-7918BG-II(HYB)(CHECK)	4.20 (2.16)	8.03 (2.92)	9.53 (3.17)	12.67 (3.62)	12.57 (3.50)	17.60 (4.24)	20.17 (4.54)	27.33 (5.27)	30.00 (5.52)	36.73 (6.09)	15.93 (4.05)	2602
	SEm ±	NS	0.09	NS	0.22	0.22	0.19	NS	0.17	0.13	0.19	0.06	109.3
	CD at 5 %	NS	0.28	NS	0.70	0.71	0.59	NS	0.55	0.41	0.61	0.20	327.7

	CV %	-	6.42	-	10.24	9.72	7.24	-	5.71	4.90	5.47	2.67	9.75

Values in parentheses are square root transformed values $\left(\sqrt{x+0.5}\right)$

Seed cotton yield

The Highest seed cotton yield (table 4) was observed in ACH-1199-2BG-II(2699 kg/ha and found at par with standard check MRC-7918 BG-II(2602 kg/ha) followed by ACH-104-2BG- II (2262 kg/ha), ACH-1133-2BG -II (2022 kg/ha), ACH-152-2BG-II(2108 kg/ha), standard check RCH-2 BG-II (1795 kg/ha.), ACHB-90-1BG-II (1738 kg/ha.), ACH-104-2BG-II (1463kg/ha.) ACH-1BG-II (1045kg/ha). Bennett *et al.* (2004) reported that cotton growers have increased yield on adopting *Bt* cotton. Similarly, Zahid *et al.* (2004) revealed that *Bt* cotton recorded significantly higher yield than the non-transgenic cotton. Further Shera, et al (2014) also recorded the highest mean seed cotton yield (2342 kg/ha) in RCH 134 *Bt* recorded as compared to other test *Bt* hybrids (851 to 2083 kg/ha). In the same way The above findings are in the line of agreement with the present study.

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RESEARCH ARTICLE

FORAGING BEHAVIOUR OF GIANT BEE, *APIS DORSATA* (HYMENOPTERA-APIDAE) ON *AGERATUM CONYZOIDES* IN NORTHERN HILL ZONE OF CHHATTISGARH

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Abstract: A field investigation was undertaken at Raj Mohini Devi College of Agriculture and Research Station, Ambikapur under substation of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during 2016-17 for the purpose of foraging behaviour of rock bee, *Apis dorsata* on *Ageratum conyzoides*. During the first week of October the bee visitation was recorded minimum at 0900hrs (0.83 bees/5min/m^2) and it was suddenly increased at 1100hrs (2.77 bees/5min/m^2), after that it was declined (1.66 bees/5min/m^2) at 1300hrs and 1.11 bees/5min/m^2 at 1500hrs and the lowest was recorded (0.72 bees/5min/m^2) at 1700hrs and the mean bee population was recorded (1.41 bees/5min/m^2). The average maximum bee population (5.43 bees/5min/m^2) was recorded during the 2nd week of January 2017 followed by 2nd week of Nov 2016 (5.00 bees/5min/m^2). However, at the hours of the day the bee visitation was noticed (2.51 bees/5min/m^2) at 0900hrs and increased its peak at 1100hrs (7.67 bees/5min/m^2) and it was started declined (5.83 bees/5min/m^2) at 1300hrs, 3.05 bees/5min/m^2 at 1500hrs and 1.37 bees/5min/m^2 at1700hrs. The highest average population was recorded at 1100hrs(7.67bees/5min/m^2).

Keywords: *Apis dorsata*, *Ageratum conyzoides*, Foraging behaviour, Weed.

INTRODUCTION

This weed, *Ageratum conyzoides* belongs to family Asteraceae is popularly known as Basnahi in Surguja region. It is also called various names in various states of India like goat weed, billy goat weed, tropical whiteweed, in Hindi it is also called Jangli pudina, Visadodi, Gha buti in Marathi-ghanera osaadi, Kannada- Oorala gida,Helukasa, Tamil- Pumppillu,Appakkoli, Bengali- Uchunti and in Nepali- Bhedda Jhar. It is a noxious and annual weed found all the seasons but winter season is favorable for its growth and multiplication. It is a herbaceous erect, height is about 30 to 100 cm its stem is covered with white hairs. It bears blue color flower and it is a good source of pollen due to which the bees are attract at the flowers. The root is well branched tap root, Stem Herbaceous, erect, cylindrical, branched, solid, hairy, green. Leaves Ramal and cauline, opposite, ovate, serrate, acute, hairy, unicostate reticulate, green. Inflorescence Capitulum, different capitula are arranged in corymbose manner, involucre of bracts is present outside the capitula. Flowers Sessile, complete, hermaphrodite, actinomorphic, penntamerous, epigynous, violet. Calyx made up of 5 sepals, polysepalous, valvate, very much reduced, green. Fruits Cypsela, black in colour, sharply trig nous, glabrous or hairy on angles only.

MATERIALS AND METHODS

The foraging behaviour of giant bee, *Apis dorsata* was recorded on a weed, *Ageratum conyzoides* at two hours interval starting from morning 0900hrs to evening 1700hrs.The activity of bees was recorded weekly and randomly selected one square meter area within five minutes by visually observed and counted the population of bees.

RESULTS AND DISCUSSION

The result depicted in table 1.The foraging activity was recorded from first week of October 2016 from 0900hrs to 1700hrs two hours intervals. During the morning hours at 0900hrs the population of giant bee was noticed (0.83 bees/5min/m^2) and increased (2.77 bees/5min/m^2) at 1100hrs and started decline at (1.66 bees/5min/m^2), 1.11 bees/5min/sqm at 1500hrs and 0.72bees/5min/m^2 at 1700hrs respectively. The average population was recorded1.41 bees/5min/m^2.

During the 2nd week of October lowest population was recorded at 0900hrs (1. 77 bees/5min/m^2 and increased at 1100hrs (7.27 bees/5min/m^2) and decreased 4.72 bees/5min/m^2 at 1300hrs, 4.16 bees/5min/m^2 at 1500hrs and 1.94 bees/5min/m^2 at 1700 bees/5min/m^2 respectively. The average population was recorded 3.97 bees/5min/m^2.

During the 3rd week of October 2016 the maximum population was recorded at 1100hrs 6.11 bees/5min/m^2 and lowest was recorded 1.38 bees/5min/m^2 at 1700hrs. The average population was recorded 3.97 bees/5min/m^2 .

During the 4th week of October, lowest population was recorded at 1700hrs (1.72 bees/5min/m^2) however the highest population was recorded at 1100hrs (8.38 bees/5min/m^2) and decreased (5.55 bees/5min/m^2) at 1300hrs, 2.50 bees/5min/m^2 at

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1500hrs and 2.27 bees/5min/m^2 at 0900hrs. the average population was noticed 4.08 bees/5min/m^2.

During the last week of October maximum population was recorded 8.94 bees/5min/m^2 at 1100hrs followed by 5.72 bees/5min/m^2 at 1300hrs and 4.16 bees/5min/m^2 at 1500hrs lowest was found 2.16 bees/5min/m^2 at 0900hrs. The average population was recorded 4.65 bees/5min/$m^{2.}$

During the first week of November maximum bee visitation was recorded at 1100hrs (7.27 bees/5min/m^2) followed by 4.72 bees/5min/m^2 at 1300hrs and 4.33 bees/5min/m^2 at 1500hrs however the lowest was record 0.83 bees/5min/m^2 at 1700hrs. Average population was recorded 3.93 bees/5min/$m^{2.}$

During the second week of November the lowest population was recorded 1.38 bees/5min/m^2 at 1700hrs. However the highest population was recorded 10.05 bees/5min/m^2 at 1100hrs and it was decreased at 6.05 bees/5min/m^2 and 4.88 bees/5min/m^2 at 1300hrs and 1500hrs respectively. The average population was 5.00 bees/5min/$m^{2.}$

During the 3rd week of November 2016 highest population was recorded 7.66 bees/5min/m^2 at 1100hrs and the lowest population was recorded 0.83 bees/5min/m^2 at 1700hrs. The average population was recorded 4.21 bees/5min/$m^{2.}$

During the 4th week of November maximum population was recorded 7.72 bees/5min/m^2 at 1100hrs however the lowest was noticed 1.72 bees/5min/m^2 at1700hrs. The average population was recorded 3.96 bees/5min/$m^{2.}$

During the first week of December highest population was recorded 8.05 bees/5min/m^2 at 1100hrs followed by 6.38 bees/5min/m^2 and 2.50 bees/5min/m^2 at 1300hrs and 1500hrs respectively. However, the lowest population was recorded 1.66 bees/5min/m^2 at 1700hrs.The averge population was recorded 4.07 bees/5min/m^2.

During the 2nd week of December highest and lowest population was recorded at 1100hrs (7.27 bees/5min/m^2) and 1.55 bees/5min/m^2 at 1700hrs. The average population was recorded 3.91 bees/5min/$m^{2.}$

During the 3rd week of December the maximum population was recorded 7.83 bees/5min/m^2 at 1100hrs followed by 6.94 bees/5min/m^2 and 2.50 bees/5min/m^2 at 1500hrs. Lowest was recorded 1.38 bees/5min/m^2 at 1700hrs. The average population was recorded 4.13 bees/5min/$m^{2.}$

During 1st week of January 2017 the population of bee was recorded lowest 1.38 bees/5min/m^2 at 1700hrs however the highest was 6.94 bees/5min/m^2 at 1100hrs. The average population was recorded 4.21 bees/5min/$m^{2.}$

During 2nd week of January maximum population was recorded 10.5 bees/5min/m^2 at 1100hrs followed by 7.00 bees/5min/m^2 at 1300hrs and 4.50 bees/5min/m^2 at 1500hrs and the minimum was recorded 1.55 bees/5min/m^2 at 1700hrs. The average population was recorded 5.43 bees/5min/$m^{2.}$

During the third week of January the highest population was recorded 7.33 bees/5min/m^2 at 1100hrs and lowest was recorded at 1700hrs (1.22 bees/5min/m^2). The average population was recorded 3.95 bees/5min/$m^{2.}$

During the 4th week of January maximum population was recorded 8.94 bees/5min/m^2 at 1100hrs followed by 4.16 bees/5min/m^2 and 2.27 bees/5min/m^2 at 1300hrs and 1500hrs respectively. The minimum population was recorded at 1700hrs 1.00 bees/5min/$m^{2.}$ The average population was recorded 3.99 bees/5min/$m^{2.}$

The results are close agreement with the earlier workers Dalio (2013 and 2015) recorded the faraging behaviour of honey bee on Parthenium and Trianthema, Fazal Said et al (2015) on sunflower, Painkra (2016) on lajwanti grass, Painkra and Shaw (2016) on niger flowers. Kaur and Kumar (2013) and Roy (2014) on mustard.

Table 1. Foraging activity of giant bee on *Ageratum conyzoides* during 2016-17.

Date of observation	**Population of honey bees / 5min /m^2**					**Total**	**Mean**
	Hours of the day						
	0900	**1100**	**1300**	**1500**	**1700**		
1-7 /10/2016	0.83	2.77	1.66	1.11	0.72	7.09	1.41
8-14/10/2016	1.77	7.27	4.72	4.16	1.94	19.86	3.97
15-21/10/2016	1.94	6.11	5.27	1.94	1.38	16.64	3.32
22-28/10/2016	2.27	8.38	5.55	2.50	1.72	20.42	4.08
29-4/11/2016	2.16	8.94	5.72	4.16	2.27	23.25	4.65
5-11/11/2016	2.50	7.27	4.72	4.33	0.83	19.65	3.93
12-18/11/2016	2.66	10.05	6.05	4.88	1.38	**25.02**	**5.00**
19-25/11/2016	2.83	7.66	5.61	4.16	0.83	21.09	4.21
26-2/12/2016	2.55	7.72	4.88	2.94	1.72	19.81	3.96
3-9/12/2016	1.77	8.05	6.38	2.50	1.66	20.36	4.07
10-16/12/2016	2.11	7.27	5.83	2.83	1.55	19.59	3.91
17-23/12/2016	2.00	7.83	6.94	2.50	1.38	20.65	4.13
24-30/12/2016	2.11	7.44	6.38	1.94	0.83	18.70	3.74

31-6/01/2017	3.94	6.94	5.72	3.11	1.38	21.09	4.21
7-13/01/2017	3.61	10.5	7.00	4.50	1.55	**27.16**	**5.43**
14-20/01/2017	4.16	7.33	4.88	2.16	1.22	19.75	3.95
21-27/01/2017	3.61	8.94	4.16	2.27	1.00	19.98	3.99
Total	**42.82**	**130.47**	**91.47**	**51.99**	**23.36**	**340.11**	
Mean	2.51	**7.67**	**5.38**	**3.05**	**1.37**	**20.00**	

Plate 1. *Apis dorsata* foraging on *Ageratum* flower

Plate 2. *Ageratum* flower

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RESEARCH ARTICLE

GROWTH AND PERFORMANCE OF SRI VENKATESWARA CO-OPERATIVE SUGAR LTD.: A STUDY IN CHITTOOR DISTRICT

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Abstract: Sugarcane is an important commercial crop cultivated in about 120 countries in the world. Sugarcane is cultivated in an area of 42.40million hectares in the world. Sugar industry is the second largest in India and first being the textile.This study is mainly based on financial indicators. The secondary data was collected from2009-10 to 2013-14. The performance of sugar industry was examined by the financial indicators through financial analysis. The results revealed that, the increase in share capital contributed by members was quite negligible because sugar factory was unable to maximize the profits. For a rupee of capital employed in fixed assets and current assets by the company, the sales revenue generated by the company was highly fluctuating. The factory was incurring losses over the study period and the operating expenses of the company were also kept on the higher side. Factory may follow the strategies on par with private factories in procurement of sugarcane, payment method to sugar farmers and marketing of sugar and it would increase the profits.

Keywords: Sugar factory, Financial indicators, Financial analysis

INTRODUCTION

Sugarcane is an important commercial crop cultivated in about 120 countries in the world. Sugar industry is the second largest in India and first being the textile.

Sugarcane is cultivated in an area of 42.40million hectares in the world. The total area under sugarcane cultivation is highest in Brazil (6.20 million hectares) followed by India (5.01million hectare). Brazil is the biggest producer of sugar accounting for 41.4 per cent of the world sugarcane production followed by India (17.7 %). Other major producers of sugarcane are China (6.6 %), Thailand (4.5 %), Pakistan (3.0 %) and Mexico (2.9 %). Over 3/4th of the total sugar produced is consumed domestically in which it is produced and the rest is traded around the globe which is often termed as"world sugar". For this purpose liability, total assets, sales and annual losses of the sugar factory were examined.

Objective of the study

To evaluate the growth and performanceof sugar factory in terms of financial indicators.

METHODOLOGY

Secondary data was used for analysis in the presentstudy. The data on current liabilities and total assets of sugar industry were collected fromSri venkateswara co-operative sugar ltd., Gajulamandyam village, Renigunta town, Chittoor district of Andhra Pradesh for the period from 2009-10 to 2013-14.Financialanalysis was employed for analysing the financial indicators viz., share capital,reserves, loans, deposits and borrowing, cash credit pledge, current liabilities, fixed assets and current assets.

RESULTS AND DISCUSSION

The findings of this study are presented under following financial indicators. Table 1 represents the liabilities of the sugar factory in Sri Venkateswara co-operative sugar Ltd.Data pertained to various financial indicators was collected from financial statements maintained by the factory and analysis of the same was carried out for a period of five years i.e. from 2009-10 to 2013-14.The liabilities of the factory include the share capital, reserves, loans, current liabilities and central subsidy. The share capital of the factory contributed by government and institutions remained constant from 2009-10 and 2013-14 i.e. Rs.26,27,04,949 and Rs.1,05,000 respectively. The share capital contributed by members for the year 2009-10 was Rs.82,95,800 and 2010-11, 2011-12 it was Rs. 83,12,400 and for 2012-13,2013-14 it was Rs.83,32,800 and Rs. 83,46,600 respectively. The increase in share capital contributed by member was quite negligible during the study period. The reservesof the factory in the year 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 was Rs.13,07,23,464, Rs.13,11,96,178,13, Rs.15,60,081, Rs.13,18,49,044 and Rs.13,20,83,500 respectively. This implies there was negligible increase in the reserves over a period of five years (increased by 0.017 %). The loans in the form of deposits and borrowing availed by the factory for the year 2009-10, 2010-11, 2011-12,2012-13, and 2013-14 it was Rs.18, 91, 08, 204, Rs.15, 63, 34, 674,Rs.29,15,78, 867, Rs.22,89,61,701, and Rs.33, 63,22,849 respectively.The borrowing of the factory has been increasing since 2009. From the cash credit pledge availed by the factory for the year 2009-10,2010-11,2011-12,2012-13 and 2013-14 it was Rs,

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13,76,00,070, Rs.26,08,24,589,Rs.26,04,02,306, Rs.20,89,21,544 and Rs.24,46,91,319 respectively. The cash credit pledge availed by the factory was recorded highest for the year 2010-11 and then the figures reflect decreasing trend.

Current liabilities of the factory are in two forms. They are payables and sundry creditor. Payables for the year 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 was Rs.12,4148,469, Rs.27,48,09,534, Rs.5,22,36,171, Rs. 23,64,01,729 and Rs. 27,92,77,309 respectively.Sundry creditors for the year 2009-10, 2010-11, 2011-2012, 2012-13, 2013-14was Rs. 96,62,779, Rs.2,36,26,532, Rs.3, 55, 58,149, Rs.2,85,08,496 and Rs.4,04,93,461 respectively. Central subsides of the factory contributed by the financial institutions had remained unchanged at the value of Rs.15,00,000 from 2009-10 to 2013-14.

The total assets of the factory include fixed assets and current assets. Table 2 indicates assets of the sugar factory from 2009-10 to 2013-14. Results revealed that the fixed assets of the factory remained same from 2009-10 to 2011-12 (Rs.11,52,26,249). They found to be Rs. 11,52,27,521 and Rs. 11,52,29,126 in 2012-13 and 2013-14.Thus the fixed assets of the factory increased by a negligible amount from 2009-10 to 2013-14.Other than Stock, it is inferred that the current assets of the factory other than stock for the year 2009-10 was Rs.43,34,33,655, for 2010-11 it was Rs.47,28,44,862(increased by 9 %) for 2011-12 it was Rs. 53,96,25,667(increased by14 %) for 2012-13 it was Rs. 49,50,99,627 (decreased by 8.26 %) and for 2013-14 it was Rs.49,27,08,753 (decreased by 0.48 %). The current assets of the factory other than stock increased till 2011-12 and then noticed a short fall. It is inferred that the stock available with the factory was in three forms viz levy sugar, free sugar and molasses. The levy sugar of the factory for the year 2009-10 was Rs.1,19,26,043, for 2010-11 it was Rs. 2, 85 ,81,911(increased by 139 %) for 2011-12 it was Rs.1,72,63,900(decreased by39.5 %) for 2012-13 it was Rs.2,54,94,662(increased by 47.6 %) and there was no levy sugar in the year of 2013-14. The free sugar of the factory for the year 2009-10 was Rs. 13,11,12,432 for 2010-11 it was Rs. 29, 24, 45,400(increased by 123 %) for 2011-12 it was Rs.30,98,67,400(increased by5.9 %) for 2012-13 it was Rs.28,57,31,600 (decreased by 7.78 %) and for 2013-14 it was Rs.33,30,89,736(increased by 16.5%). The molasses of the factory for the year 2009-10 was -Rs. 1,63,09,332 for 2010-11 it was Rs.1,60,80,493 (decreased by 1.40 %) for 2011-12 it was Rs.97,90,021(decreased by39.1 %) for 2012-13 it was Rs.1,27,36,095(increased by 30.0 %) and for 2013-14 it was Rs.1,70,43,252(increased by33.8 %). The year 2010-11 has noticed highest percentage increase of levy sugar (13.9%) and free sugar (12.3%).

The data pertaining to these sales and annual loss was collected and discussed below. The sale of the factory was done in three forms viz: Levy sugar, free sugar and molasses. From the Table 3, it is inferred that the levy sugar for the year 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 was Rs. 2,46,10,460, Rs. 1,70,37,674, Rs.4,28,50,855, Rs. 2,27,07,868 and 21,685,000 respectively. The free sugar for the year 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 was Rs. 49,61,79,829, Rs. 19,02,63,080, Rs.36,21,80,664, Rs.47,45,01,715 and Rs.29, 52, 05,195 respectively. The molasses for the year 2009-10, 2010-11, 2011-12, 2012-13 and 2013-14 was Rs. 2,97,09,500, Rs.1,62,16,643, Rs. 1,93,65,656, Rs.1, 89,26,446 and Rs.3,32,62,000 respectively. The total sales of the factory for the year 2009-10 was Rs.550,499,789 for 2010-11 it was Rs. 223, 517, 397(decreased by 59.3 %) for 2011-12 it was Rs.1,72,63,900(increased by89.8 %) for 2012-13 it was Rs.516,136,029(increased by 21.6 %) and 2013-14 it was Rs.328,488,880 (decreased by 36.3%) respectively.

It is inferred that the annual loss of the factory for the years 2009-10, 2010-11, 2011-12, 2012-13, 2013-14 was Rs.44,63,01,260, Rs.53,13,42,742 (increased by 0.19%), Rs.58,91,04,288 (increased by 10.8%), Rs.52,69,55,495 (increased by 0.10 %), Rs. 69,75,87,105 (increased by 32.3%) .The sugar factory was facing losses over the study period and losses were recorded maximum for the year 2013-14 (losses increased 32.3%).

Table 1. Liabilities of the sugar factory from 2009-10 to 2013-14.

Sl. No.	Parameters	2009-10	2010-11	2011-12	2012-13	2013-14
1.	Share capital					
	a. overnment	26,27,04,949	26,27,04,949 (0)	26,27,04,949 (0)	26,27,04,949 (0)	26,27,04,949 (0)
	b. Member	82,95,800	83,12,400 (0.2)	83,12,400 (0)	83,32,800 (0.2)	83,46,600 (0.16)
	c. Institutions	1,05,000	1,05,000 (0)	1,05,000 (0)	1,05,000 (0)	1,05,000 (0)
	Total:	27,11,05,749	27,11,22,349 (0.06)	27,11,22,349 (0)	27,11,42,749 (0.007)	27,11,56,549 (0.005)

2.	Reserves	13,0723464	13,11,96,178 (0.36)	13,15,60,081 (0.27)	13,18,49,044 (0.21)	13,20,83,500 (0.017)
3.	Loan: a. eposits and borrowing b. ash credit pledge	 18,91,08,204 13,76,00,070	 15,63,34,674 (-17.3) 26,08,24,589 (89.5)	 29,15,78,867 (86.5) 26,04,02,306 (0.16)	 22,89,61,701 (-21.4) 20,89,21,544 (-19.7)	 33,63,22,849 (46.8) 24,46,91,319 (17.1)
4	Current liabilities: a. ayables b. undry Creditors	 12,41,48,469 96,62,779	 27,48,09,534 (121) 2,36,26,532 (144)	 25,22,36,171 (8.2) 3,55,58,149 (50)	 23,64,01,729 (-6.27) 2,85,08,496 (-19.8)	 27,92,77,309 (18.1) 4,04,93,461 (42.0)
5.	Central Subsidy	15,00,000	15,00,000	15,00,000	15,00,000	15,00,000

Table 2. Total assets of the sugar factory from 2009-10 to 2013-14

Sl. No.	Parameter	2009-10	2010-11	2011-12	2012-13	2013-14
1.	Fixed assets:	11,52,26,249	11,52,26,249 (0)	11,52,26,249 (0)	11,52,27,521 (0.001)	11,52,29,126 (0.001)
2.	Current assets: a. Other than stock:	 43,34,33,655	 47,28,44,862 (9.0)	 53,96,25,667 (14.1)	 49,50,99,627 (-90.8)	 49,27,08,753 (-0.48)
3.	Stock: a. Levy sugar b. Free sugar c. Molasses	55,04,99,789 1,19,26,043 13,11,12,432 1,63,09,332	22,35,17,397) (-59.3) 2,85,81,911 (13.9) 29,24,45,400 (12.3) 1,60,80,493 (-1.40)	42,43,97,175 (89.8) 1,72,63,900 (-39.5) 30,98,67,400 (5.9) 97,90,021 (-39.1)	51,61,36,029 (21.6) 2,54,94,662 (47.6) 28,57,31,600 (-7.78) 1,27,36,095 (30.0)	32,84,88,880 (-36.3) 33,30,89,736 (16.5) 1,70,43,252 (33.8)

Table.3 Sales and annual losses of the sugar factory from 2009-10 to 2013-14

Sl.No.	PARAMETER	2009-10	2010-11	2011-12	2012-13	2013-14
1.	**Sales:**					
	1.Levy Sugar	2,46,10,460	1,70,37,674	4,28,50,855	2,27,07,868	21,685,000
	2. Free sugar	49,61,79,829	19,02,63,080	36,21,80,664	47,45,01,715	29,52,05,195
	3.Molasses	2,97,09,500	1,62,16,643	1,93,65,656	1,89,26,446	3,32,62,000
	Total Sales:	550,499,789	223,517,397 (-59.3)	424,397,175 (89.8)	516,136,029 (21.6)	328,488,880 (-36.3)

2.	**Annual loss**	44,63,01,260	53,13,42,742 (0.19)	58,91,04,288 (10.8)	52,69,55,495 (-0.10)	69,75,87,105 (32.3)

CONCLUSION

The increase in share capital contributed by member was quite negligible because sugar factory was unable to maximize the profits.There was negligible increase in the reserves over a period of five years (increased by 0.017 %). The sugar factory was facing losses over the study period. The sale of the sugar factory was decreased (-36%) and losses were increased (32.3%).For a rupee of capital employed in fixed assets and current assets by the company, the sales revenue generated by the company was highly fluctuating. Factory was selling the sugar with lower price when compared to market price. This was the reason to incurred losses of sugar factory. The factory was incurring losses over the study period and the operating expenses of the company were also kept on the higher side.Andhra Pradesh co-operative bank giving fund as a grant to the sugar factory but still it is in loss. So, to maximize the profit, factory may follow the strategies on par with private factories in procurement of sugarcane, payment method to sugar farmers and marketing of sugarandit would increase the profits.

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RESEARCH ARTICLE

INFLUENCE OF SOWING DATES AND PLANT DENSITIES ON GROWTH PARAMETERS OF SOYBEAN (*GLYCINE MAX* (L.) MERRILL)

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Abstract: A field experiment was conducted during *kharif* season, 2014 to study the influence of different sowing dates and plant densities on growth parameters of soybean. It was comprised of nine treatments with three sowing dates (June 28, July 14 and July 29) as main plot treatments and three row spacing of soybean (30 cm x 10 cm, 45 cm x 10 cm and 60 cm x10 cm) as sub plot treatments and replicated three times. Plant height, dry matter production, leaf area index (LAI), and Days to 50 per cent flowering increased with early sowing crop on June 28 than other two delayed sowings July 14 and July 29. July 14 sown crop is on par to June 28 sown crop. Growth parameters of soybean were inconsistent with different row spacings. The highest plant height, dry matter production and leaf area index (LAI) was recorded at a spacing of 30 X 10 cm, more number of days to 50 percent flowering were recorded at spacing of 60 cm x 10 cm.

Keywords: Sowing dates, Plant densities, Soybean, Growth parameters

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is an important oilseed crop, which plays an important role in the economy of India. Soybean has now established as number one crop among oilseeds and contributes more than 50 per cent of oilseed production and 30 per cent of vegetable oil production in India (Anonymous, 2008). It is a good source of protein (40%), Oil (20%), unsaturated fatty acids and minerals like Ca and P including vitamin A, B, C, D which can meet-up different nutritional needs of human and animals (Mondal *et al*. 2012). Besides its main use for oil extraction, it can be used as dal, soya milk, *tofu* etc. In 2013, it occupied an area of 12 mha in India with production of 12.8 million tones and with productivity of 1079 kg/ha. It is mainly grown in Madhya Pradesh, Maharashtra and Rajasthan (Anonymous, 2008). The productivity of soybean is low due to various constraints. The time of sowing has a considerable influence on growth and yield of soybean. Early sowing in the season may encourage higher vegetative growth which may invite various diseases and insects pests. However, delayed sowing may shrink the vegetative phase, which in turn reduces dry matter accumulation leading to poor partitioning to reproductive parts and ultimately poor realization of the potential yield. In addition to sowing time planting density is one of the main factors that has an important role on growth and yield of soybean. Optimum plant density ensures proper growth of the aerial and underground parts of the plant through efficient utilization of solar radiation, nutrients, land as well as air spaces and water (Malek *et al*. 2012). There are two general concepts to describe the relationship between plant density and seed yield. Firstly, irrespective of plant spacing within and among rows, plant density must be such that the crop develops a canopy able to intercept more than 95% of the incoming solar radiation during reproductive growth and secondly, a nearly equidistant plant arrangement minimizes interplant competition and produces maximum seed yield. Kang *et al.* (2001) reported that appropriate plant density and cultivar is necessary for obtaining high yield and quality of soybean. The optimum plant density for higher yield may differ from cultivar to cultivar and location to location. There was a need to study the optimum sowing time and optimum plant density for producing higher yield. Therefore, an experiment was initiated in 2014 to study the optimum sowing time and optimum plant density.

MATERIALS AND METHODS

A field experiment was conducted during *kharif*, 2014 at college farm, agricultural college, Mahanandi, ANGRAU. The soil of the experimental site was sandy loam and it was slightly alkaline in reaction with a pH of 7.98, EC of 0.06 dSm^{-1} and low in organic carbon (0.46%) and available nitrogen (266 kg ha^{-1}), medium in available phosphorous (145 kg P_2O_5 ha^{-1}) and high in available potassium (774.3 kg K_2O ha^{-1}). The experiment was laid out in factorial randomized block design and replicated thrice. The treatments consisted of three sowing dates *viz.*, D_1 (June 28), D_2 (July 14) and D_3 (July 29) and three plant densities, *viz.*, S_1: 30 X 10 cm (3.33 lakh plants ha^{-1}), S_2: 45 X 10 cm (2.22 lakh plants ha^{-1}) and S_3: 60 X 10 cm (1.66 lakh plants ha^{-1}). Variety JS335 which matures in 80-85 days was tested in this experiment. A uniform dose of nitrogen, phosphorous and potassium was applied as per the recommendation @30kg N, 60kg P_2O_5 and 40kg K_2O ha^{-1} through urea, single super phosphate (SSP) and muriate of potash (MOP) respectively to all the plots. Entire quantity of phosphorous and potassium

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was applied as basal where as nitrogen was applied in two equal splits, one at the time of sowing and another at 30 days after sowing (DAS). No serious attack of pests and diseases was observed. However, minor incidence of tobacco caterpillar (*Spodoptera litura* (Fab.) was observed at flowering. Monocrotophos @ 2 ml L^{-1} and Acephate (0.08%) @ 2ml L^{-1} were used for effective control of pest. Weeding was done at 15 and 30 DAS of each sowing date to keep the plots free from weeds. When crop was subjected to prolonged dry spell to protect the crop the irrigation was given. The total rainfall received during crop growth was 515.2mm in 28 rainy days. Five plants were randomly selected in the net plot area and tagged. Plant height of these plants was recorded at 30, 60 DAS and at harvest from the base of the plant to the tip of the growing point. The mean value of five plants was computed and expressed as plant height in cm. Dry matter production was measured at 30, 60 DAS and at harvest. Five plants were randomly selected in the gross plot and dug out these plants for destructive sampling. They were oven dried at 60^0C till a constant weight is obtained. The dry weight per m^2 was calculated and expressed as kg ha^{-1}. Leaf area index (LAI) was measured at 30, 60 DAS and at harvest. The leaf area was measured by electronic leaf area meter. LAI was calculated using the formula as Leaf area from the five plants divide by ground area allowed for five plants. The number of days taken from sowing to the attainment of fifty per cent plants to flowering in the experimental plot was considered as days to 50 percent flowering.

RESULTS AND DISCUSSION

Effect of sowing dates

Growth parameters

The differences in plant height due to different sowing dates were significant from 30 days after sowing onwards to harvest. Sowing of soybean on June 28 increased the plant height (38.1 cm) significantly over rest of the sowing dates i.e. July 14 and July 29 at 30, 60 days after sowing and at harvest. Similarly next date of sowing July 14 sowing resulted in significantly taller plants than July 29 sowing at 30, 60 days after sowing and at harvest. Taller plants in early sowing date might be due to favorable environment enjoyed by early sown crop than that sown at later dates even after receiving similar inputs and less number of nodes and reduced inter nodal distances caused by non-optimal sowing time could be the reason for reduction in plant height under delayed sowing dates. Shuddhodhan and Jadhao (1986) also reported the enhancement of growth characteristics with early sowings when compared to late sown conditions in soybean. The total drymatter production increased significantly from 30 days after sowing to harvest. A gradual increase in total dry matter production was noted from 60 days after sowing. The total dry matter production recorded at June 28 sowing was significantly higher (3762 kg ha^{-1}) over the rest of sowing dates i.e. July 14 and July 29 sowings. Maximum drymatter accumulation in the early sown crop was perhaps due to more plant height, higher leaf area index and vigorous vegetative growth. These are in conformity with the results reported by Hanumantharao *et al.* (1990). The maximum leaf area index (4.1) was registered with June 28 sowing over July 14 and July 29 sowings throughout the crop growth period. Sowing of soybean on July 29 resulted in early 50 per cent flowering (35 days) than June 28 and July 14 sowings. Similarly July 14 sowing attained early flowering in soybean than June 28 sowing. The reduction in total duration from sowing to 50 percent flowering might be due to photosensitivity of soybean plant.

Effect of plant densities

With regard to spacings narrow row spacing 30 cm x 10 cm recorded more plant height (40.7 cm) than 45 cm x 10 cm and 60 cm x 10 cm spacings at 30, 60 days after sowing and at harvest. Similarly medium row spacing 45 cm x 10 cm resulted in significantly taller plants than wider row spacing 60 cm x 10 cm at 30, 60 days after sowing and at harvest. The positive relationship of closer spacing on plant height might be attributed to high inter-plant competition, which caused internodal elongation as reported by Ravichandran and Ramaswami (1992) and Halvankar *et al.* (1993). Among row spacings 30 cm x 10 cm spacing recorded highest total dry matter production (3532 kg ha^{-1}) and it was significantly superior over rest of row spacings i.e. 45 cm x 10 cm and 60 cm x 10 cm. Higher drymatter production in closer spacing may have been due to the cumulative effect of more number of plants per unit area, higher leaf area index and more light interception. Arnon (1971) indicated that dry matter yield tend to increase linearly with increase in plant density of different crops. The present findings are in accordance with the findings reported by Duraisingh and Gopalaswamy (1991) and Halvankar *et al.* (1999). Narrow row spacing of 30 cm x 10 cm recorded maximum leaf area index (4.7) over the 45 cm x 10 cm and 60cm x 10 cm spacings at all the stages of crop growth. Similarly 45cm x 10 cm spacing recorded a higher leaf area index values over 60 cm x 10 cm spacing throughout the crop growth period. Increase in leaf area index with early sowing due to favorable environment for the crop during vegetative phase. The decrease in leaf index particularly at later stages of crop growth was mainly due to leaf senescence. Similar results were reported by Halvanker *et al.* (1989) and Sahoo *et al.* (1991). With regard to row spacings narrow row spacing 30 cm x 10 cm resulted in early 50 per cent flowering (52 days) than 45 cm x 10 cm and 60 cm x 10 cm spacings. The reduction in days to 50 per cent flowering might be due to intra plant competition in dense planting. This was also

observed by Hariram *et al.* (2010) and Masum Akond *et al.* (2012).

Table 1. Growth parameters as influenced by sowing dates and plant densities

Treatment	Plant height (cm)			Dry matter production (kg ha^{-1})			Leaf area index			Days to 50% flowering
	30 DAS	60DAS	at harvest	30 DAS	60 DAS	at harvest	30 DAS	60 DAS	at harvest	
Sowing dates										
June 28	23.6	36.7	38.1	486	2228	3762	1.5	4.1	3.7	54
July 14	22.4	36.3	37.8	467	2126	3389	1.4	3.6	3.32	46
July 29	21.7	35.8	37.1	441	2005	3051	1.3	3.1	2.6	36
SEm±	0.2	0.2	0.01	1.5	0.01	17	0.009	0.006	0.05	0.1
C.D.(P=0.05)	0.66	0.05	0.01	4.43	2.03	51.57	0.02	0.01	0.16	0.38
Plant densities										
30 X 10 cm	25.0	39.1	40.7	594	2423	3532	1.8	4.7	4.2	43
45 X 10 cm	22.2	36.7	37.8	460	2049	3379	1.6	3.9	3.4	45
60 X 10 cm	20.6	33.7	34.4	341	1887	3292	0.9	2.1	1.8	48
SEm±	0.2	0.2	0.01	1.5	0.01	17	0.009	0.006	0.05	0.1
C.D. (P=0.05)	0.66	0.05	0.01	4.43	2.03	51.57	0.02	0.01	0.16	0.38
D X S										
SEm±	0.3	0.3	0.01	2.6	0.01	30	0.01	0.01	0.09	0.2
C.D.(P=0.05)	NS	0.12	0.03	10	4.61	116.9	NS	0.04	0.37	0.87

NS- Non significant

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RESEARCH ARTICLE

ISOLATION AND CHARACTERIZATION OF ANTIBIOTIC PRODUCING *ACTINOMYCETES* AGAINST CERTAIN PATHOGENS

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Abstract: Aim of the present study was isolation and identification of *Actinomycetes* against certain pathogens. *Actinomycetes* strains were isolated from cultivated field of Sudhowala, Dehardun and *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi* were also isolated from sewage at Dehradun. Both *Actinomycetes* and pathogens were characterized on the basis of microscopy and various biochemical tests. Further, we evaluated antimicrobial activity of *Actinomycetes* strains against isolated pathogens. Microscopic examination and biochemical tests confirmed that isolated strains were *Actinomycetes*, *Staphylococcus aureus*, *Escherichia coli* and *Salmonella typhi*. *Actinomycetes* did not show inhibition zone against *Staphylococcus aureus*. But crude extract of *Actinomycetes* showed 191.66, 181.81 % more inhibition zone as compare to 25% extract concentration against pathogenic *E. coli* and *Salmonella typhi* repectively. It confired that Actinimycetes effectively control growth of *E. coli* and *Salmonella typhi*.

Keywords: *Actinomycetes*, Antibacterial, *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi*

INTRODUCTION

Antibiotic is one of the important secondary metabolites or chemical compounds which are produce by few micro-organisms. These antibiotics are metabolic products of one organism which directly inhibit or kill growth of other organisms. The various types of microorganisms are present in soil. *Staphylococcus aureus*, *Escherichia coli* and *Salmonella typhi* are responsible for various type of disease in human. *Staphylococcus aureus* is a major cause of bacteremia, and it is associated with higher morbidity and mortality (Naber, 2009, Van Hal *et al.*, 2012). Food and water contamination by *Escherichia coli* has been a serious public health problem and a cause of huge economic losses worldwide. Foodborne pathogenic *Escherichia coli* contamination, such as that with *E. coli* O157 and O104, is very common, even in developed countries (Yang *et al*., 2017) and these *E. coli* strains cause diarrheal illness (Ramanathan *et al.*, 2010). Salmonella represents the major cause of bacterial foodborne infection in the United States and is considered the major cause of human salmonellosis outbreaks in worldwide (Tarabees *et al*., 2017).

Antibiotics have been used since being discovered and used as remedy for infections, inflammations and diseases (Bhuyan *et al.*, 2017). Total world production of antibiotics is more than one million tons per annum. Over 5,000 antibiotics have been identified from the cultures of Gram-positive and Gram-negative organisms, and filamentous fungi, but only about 100 antibiotics have been commercially used for treatment of diseases (Thomson and Bonomo, 2006). Fungal strains and streptomyces members are extensively used in industrial antibiotic production. The *Streptomycetes* are responsible for production of major antibiotics among antibiotics producing microorganisms (Singh *et al.*, 2012). *Actinomycetes* from the genera *Actinoplane*, *Streptomyces*, and *Actinopolyspora* have been reported to produce over 300 broad-spectrum antibiotic substances (Kieser *et al*., 2000, Wynands and van Pee, 2004). So aim of present study is isolation and characterization of antibiotic producing *Actinomycetes* against certain pathogens.

MATERIALS AND METHODS

Isolation of pathogens: 0.5 ml sewage water sample was spreaded on Mannitol salt agar (MSA), Eosin Methylene Blue (EMB) agar medium, BSA agar medium for isolation of *Staphylococcus aureus*, *Escherichia coli* and *Salmonella typhi* respectively. These plates were incubated at 37°C for 48 hours.

Isolation and characterization of antibiotic producing actinomycetes: Actinomycetes was isolated from soil of cultivated field at Sudhowala, Dehradun (U.K).

(i) Sample preparation: Soil samples were dried separately at 65°C for 1 hr, in a hot air oven and stored at room temperature for further work.

(ii) Isolation of Actinomycetes: Soil sample was diluted and spreaded on Actinomycetes Isolation Agar (AIA) medium plates and starch-casein agar medium plates aseptically in a laminar-air flow cabinet. The plates were incubated at 27 ± 2 °C for 5 days. The plates were observed intermittently during incubation. After 72 h, whitish pin-point colonies, characteristic of actinomycetes.

(iii) Characterization of isolated *Actinomycetes* strains and Pathogens: Isolated strains were characterized according to Bergey's manual of determinative bacteriology (Holt *et al*., 1994).

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(iv) **Preparation and inoculation of Antibiotic production medium:** The isolated Actinomycetes strains were transferred in sterilized production medium ISP-1 (Starch-10g, Yeast extract- 4g, Peptone-2g, Potassium bromide-5g, Iron sulphate tetrahydrate-4.76g per liter) and incubated at 27 ^{0}C for 10 days.

(v) **Extraction of crude antibiotic metabolites from the production medium:** Extract was separated by the centrifugation at 3000 rpm for 20 minutes. The pellets were discarded and supernatant was mixed with double volume of chilled acetone and left overnight. The mixture was centrifuged at 5000 rpm for 20 minutes. The crude extract of antibiotic was washed with tris-phosphate buffer.

(vi) **Determination of the antibiotic activity of partially purified extract of Actinomycetes:** Twenty milliliters of sterilized molten Mueller Hinton agar (MHA) was seeded with 50 µl of each test organisms such as *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi* aseptically poured into three different sterilized Petri dishes and allowed to solidify. Sterile cork borer (6 mm diameter) was used to bore wells in the plate, and 100 µl of the extract was then carefully dispensed into the bored holes. The extract was allowed to diffuse for about 1 h before incubating aerobically at 37°C for 24 h. The presence of a zone of inhibition around each well was indicative of antibacterial activity.

RESULTS AND DISCUSSION

All pathogenic strains were isolated from sewage water. Selective media was used for isolation of pathogens. *Staphylococcus aureus* showed bright yellow coloured colonies on MSA agar medium which is selective medium. *E. coli* strains showed distinctive metallic green sheet colonies on EMB agar medium which confirmed that isolated strains were *E. coli*. *Salmonella typhi* strains were showed distinctive black coloured colonies on BSA agar medium which confirmed that isolated strains were *Salmonella typhi*. All pathogenic strains were characterized on the basis of various biochemical tests. *Staphylococcus aureus* showed negative result in Indole test, VP test, Urease test, starch hydrolysis and sugar fermentation but showed positive reaction in MR test, Citrate test, Gelatin utilization. *E. coli* and *Salmonella typhi* showed similar biochemical tests except citrate test i.e. *Salmonella typhi* strains were citrate positive (Table 1). All biochemical tests confirmed that isolated strains were *Staphylococcus aureus*, *E. coli*, *Salmonella typhi*. Similar observations have been mentioned in Bergey's manual of determinative bacteriology (Holt *et al*., 1994) and Cowan and Steel's Manual for the identification of medical bacteria (Barrow and Feltham, 1993). Pure Actinomycetes strains were selected for biochemical identification. Actinomycetes strains showed positive tests such as Indole test, VP (Voges-Proskauer) test, Urease test, Gelatin utilization test, Starch hydrolysis test, Sucrose fermentation test, Lactose fermentation test, Glucose fermentation test but Methyl red test and citrate test negative (Table 2). All the biochemical tests are confirmed that isolated strains belong to genus *Actinomycetes*. Similarly, Dhananjeyan *et al*. (2010) reported that *Actinomycetes* strains showed positive results in methyl red, indole test, starch hydrolysis, vogus-proskauer test, catalase test and triple sugar iron test and shown negative result in fermentation of citrate. Previously, Abbas (2006) isolated actinomycetes from Kuwait saline soil and characterized *Actinomycetes* on the basis of biochemical tests. Similar observation has been observed by (Varghese *et al*., 2012, Chaudhary *et al*., 2013). Crude extract of *Actinomycetes* did not show any antibacterial activity against *Staphylococcus aeurus* but significantly inhibited the growth of *E. coli* and *Salmonella typhi*. Our result suggested that as we reduced concentration of crude extract of the *Actinomycetes* than there is redcution of antibacterial activity agianst *E. coli* and *Salmonella typhi*. 100% extract showed 191.66, 181.81 % more inhibition zone as compare to 25% extract concentration against *E. coli* and *Salmonella typhi* repectively (Table 3). Previously, Chaudhary *et al*. (2013) observed that Actinomycete Isolates AS14, AS27, and AS28 were highly active, while AS1 showed less activity against the pathogenic microorganisms i.e. Isolate AS7 exhibited the highest antagonistic activity against *Bacillus cereus* (24 mm) and AS16 showed the highest activity against *Enterococcus faecalis* (21 mm). further, Chaudhary *et al*. (2013) reported that MIC of actinomycete isolates was found to be 2.5 mg/ml against *Shigella dysenteriae*, Vancomycin-resistant enterococci, and *Klebsiella pneumoniae*, and was 1.25 mg/ml for *Staphylococcus saprophyticus*, *Streptococcus pyogenes*, *Staphylococcus epidermidis*, Methicillin-resistant *Staphylococcus*, *Bacillus*.

Table 1. Biochemical test for isolated pathogen or test organisms

Biochemical test	***Staphylococcus aureus***	***Escherichia . coli***	***Salmonella typhi***
Indole test	Negative	Positive	Positive
MR test	Positive	Positive	Positive
VP test	Negative	Negative	Negative
Citrate test	Positive	Negative	Positive
Urease test	Negative	Negative	Negative
Gelatin utilization	Positive	Negative	Negative

Starch hydrolysis	Negative	Negative	Negative
Sucrose fermentation	Negative	Positive	Positive
Lactose fermentation	Negative	Positive	Positive
Glucose fermentation	Negative	Positive	Positive

Table 2. Biochemical tests results for Actinimycetes strain

Biochemical test	**Result**
Indole test, VP (Voges-Proskauer) test, Urease test, Gelatin utilization test, Starch hydrolysis test, Sucrose fermentation test, Lactose fermentation test, Glucose fermentation test	Positive
MR (Methyl red) test, Citrate test	Negative

Table 3. Antibacterial activity of crude extract of *Actinomycetes*

S. No.	**Concentration of extract (%)**	Inhibition zone (mm)		
		Staphylococcus aeurus	*Escherichia coli*	*Salmonella typhi*
1	25	0	12±0.5	11±0.5
2	50	0	16±0.5	15±0.0
3	75	0	20±0.5	17±0.5
4	100	0	23±0.0	20±0.5

Values are mean of three replicates

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