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EFFECT OF INSECT ATTRACTANTS, MICRONUTRIENTS AND GROWTH REGULATORS ON CROP GROWTH, FLOWERING BEHAVIOUR AND SEED YIELD IN ALFALFA (*MEDICAGO SATIV*A L.)

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SUMMARY

A field experiment was carried out at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad during the Rabi-Summer 2010-11. The experiment consisted of 8 treatment combinations involving two insect attractants A_1- Jaggery solution @ 2% and A_2- Commercial attractant (Bee-Q @ 0.175%), two micronutrients M_1- Boron @ 0.8% and M_2- Molybdenum @ 0.05%, and two growth regulators G_1- Gibberlic Acid (GA_3) @ 50 ppm and G_2- Naphthalene Acetic Acid (NAA) @ 50 ppm. Among the insect attractants sprayed, Bee-Q recorded significantly higher number of flowers (271), number of pods per plant (62.75), pod set percentage (22.72), pod yield per plant (14.75) and seed weight per plant (2.83). Higher seed yield per ha (268) was noticed with Bee-Q with the extent of 18% of increase over Jaggery solution. Among the micronutrients sprayed, M_1 recorded significantly higher number of flowers (263), number of pods per plant (60.43), pod set percentage (21.96), pod yield per plant (14.28), seed weight per plant (2.31) and seed yield per ha (251). Among the growth regulators sprayed, G_1 recorded significantly higher number of flowers (269), number of pods per plant (63.45), pod set percentage (22.85), pod yield per plant (14.02), seed weight per plant (2.46) and seed yield per ha (267). The interaction effects between insect attractants, micronutrients and growth regulators were found significant. The treatment combination of $A_1M_2G_1$ found significantly superior for pod set % and seed yield per ha over all other treatment combinations.

Key words : Lucerne, boron, molybdenum, gibberlic acid and naphthalene

Lucerne (*Medicago sativa,* L) is popularly known as Alfalfa and considered as one of the important forage legumes. Lucerne is a small seeded crop, and has a slowly-growing seedling, but after several months of establishment, forms a tough crown at the top of the root system. This crown contains many shoot buds that enables alfalfa to re-grow many times after being grazed or harvested. In India lucerne occupies one million ha area and provides 60-130 tones of green forage per ha. It is grown as a farm crop in Gujarat, Maharastra, Punjab, Western districts of U.P and West Bengal. After sorghum and berseem, lucerne is 3rd important forage crop in India (Anonymous, 2010).

Low seed production in lucerne is mainly related with (1) poor translocation of water soluble sugar from vegetative to reproductive organs (2) poor translocation mechanism of sugars (3) low productive potential of flowers developed in the later stage (4) non synchronization habit and (5) prolonged flowering drop, uneven pod maturity and pod shattering (Manomani *et al.,* 2002).

Seed production in lucerne requires high dexterity, timeliness and conducive climate conditions. Commercial varieties of lucerne are completely self sterile and require insect pollination to facilitate tripping mechanism. Seed production requires the presence of pollinators when the fields of alfalfa are in bloom. Due to this, seed yield of lucerne crop was 2.2 to 4.5 q/ha. Seed yield of lucerne varies capriciously and affects due to pollination failure. Production of quality seed is one

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of the major set back in lucerne, as it requires tripping mechanism for pollination. Hence, it is essential to know the influence of insect attractants in improving the seed set percentage, seed yield and quality. Seed production is the resultant of number of developmental phases requiring specific nutrients to maintain the metabolic status of plant during reproductive phase. Spraying of growth regulators and micronutrients is known to bring rapid changes in metabolic balance of growth and partitioning of assimilates as well as the quantity and quality of desired economic part in lucerne (Hazra and Sinha, 1996).

Application of growth regulators and micronutrients for optimistic plant production by modifying the growth development and stress behaviour has increased the quantitative and qualitative yield of lucerne crop. Suitable concentrates of growth regulators applied at appropriate time and stage have increased the seed yield in lucerne (Yadava *et al.* 1984). Hence, there is a need to understand the role of micronutrients and growth regulators in increasing the seed yield and seed quality in lucerne crop. Keeping this in view, the present investigation entitled "Influence of insect attractants, micronutrients and growth regulators on seed production in Alfalfa (*Medicago sativa* L.") was carried out.

MATERIALS AND METHODS

The experiment was conducted during *Rabi* season of 2010-11 at the field experiment was conducted at Main Agricultural Research Station, University of Agriculture Sciences, Dharwad. The certified seeds of lucerne variety RL-88 were procured from Indian Grass land and Fodder Research Institute (IGFRI), Regional Centre, Dharwad and used for the study. The experiment consisted of 8 treatment combinations involving two insect attractants, A_1- Jaggery solution @ 2% and A_2- Commercial attractant (Bee-Q @ 0.175%), two micronutrients M_1- Boron @ 0.8% and M_2- Molybdenum @ 0.05% and two growth regulators. G_1- Gibberlic Acid (GA_3) @ 50 ppm and G_2- Naphthalene Acetic Acid (NAA) @ 50 ppm. Experiment was laid out in randomized block design with factorial concept and replicated thrice. According to standard seed production package of practice seeds were treatment with *Rhizobium meliloti*. The seeds of lucerne cv. 'RL-88' were hand sown @ 20 kg per hectare to the depth of 2-3 cm in the furrows spaced at 30 cm apart in all the plots. To get more number of tillers and flowers and to reduce the vegetative growth in lucerne, crop cutting was recommended. The crop cutting done at 70, 95 and 120 days after sowing by cutting the plants at base leaving 3-4 cm above the ground. The insect attractants, micronutrient and growth regulators solutions required to spray for one experimental plot was calculated and prepared accordingly. All these were sprayed to as per plan of layout on same day at the time 50 per cent flowering. All the cultural package of practices was conducted from time to time. Five plants were selected at random and labelled in each net plot for recording observations. The plant height was recorded in centimetres from the base of the plant to the tip of the main stem of the plant at final harvest. The average of the five plants was considered as the average height of the plant. At harvest stage, the total number of branches were counted on tagged plants, then the average was computed and expressed as number of branches per plant at harvest. All flowers were counted on tagged plants, and then the average was computed and expressed as number of flowers per plant at time of 100 % flowering. The percentage of pod set was calculated by using the formula

$$\text{Pod set (\%)} = \frac{\text{Number of pods per plant}}{\text{Number of flowers per plant}} \times 100$$

The total number of pods formed on each plant was counted at harvest, the average of the five plants was considered as the average number of pod per plant. The total numbers of pods in each plant were weighed and then divided by the total number of the pods in each plant and expressed in grams. Ten pods per plant were randomly selected from each of the five tagged plants and separated the seed manually. The average was computed and expressed as number of seeds per pod. After harvest the total pods per plant was weighed and recorded as pod yield per plant. The average was worked out and expressed as pod yield in gram per plant. All the pods of each tagged plant were manually threshed and cleaned. The weight of the seed obtained from each plant was recorded and average was worked out and expressed as seed yield per plant in grams. Seed yield per ha was calculated by using the seeds yield obtained from the corresponding net plot and care was taken to add the weight of the five separately harvested plants.

Seed yield per hectare was computed and expressed in kilogram. The data collected in respect to various parameters on growth and seed yield attributes were analyzed statistically as described by Gomez and Gomez (1984). The critical difference (CD) values were calculated at 5 per cent (P=0.05) probability level where ‘F’ test was significant.

RESULTS AND DISCUSSION

In India, Lucerne is one of the most important forage leguminous crops. However, the crop posses a problem in seed production, as it requires tripping mechanism for pollination. Lucerne after sowing makes rapid growth, both in height as well as in branching under specific management practices (Singh and Sinha, 1988). The major constraint in lucerne cultivation is the availability of quality seeds for sowing. Successful lucerne seed production involves adequate pollination, mineral nutrition and adjustment of cultural and management practices for local condition. In Lucerne, the pollen tube mainly fails to fertilize ovules reason the being in sufficient pollen tube length which cause low seed set and low seed yield. Hence, there is a need of insect populations to trip the pollination mechanism and improve the seed set. Use of micronutrients plays a specific role in crop growth. The exogenous substances such as crop growth regulators and micronutrients known to bring the metabolite balance of growth and partitioning of assimilates as well as quality and quantity of the desired economic products in crop plants (Hazra and Sinha, 1996).

The data on plant height, number of branches per plant, number of flowers per plant, number of pods per plant and Pod set % are furnished in the Table 1. The present study indicated that, the foliar application of insect attractants (Jaggery solution and Bee-Q), micronutrients (Boron and Molybdenum) and growth regulators (Gibberilic Acid and Naphthalene Acetic Acid) at 50 per cent flowering stage showed significantly higher plant height (87.37 cm) in Bee-Q commercial attractant in Boron spray treatment (84.98 cm)and Gibberilic Acid treatments as compared to others. Among the combinations of insect attractants and micronutrients, A_2M_2 (Bee-Q + Molybdenum) found significantly superior in producing the higher plant height as compared to other treatment combinations. The spraying of commercial Bee-Q attractant with Gibberilic Acid recorded significantly higher plant height at harvest. The higher plant height was noticed in plants sprayed with Bee-Q commercial attractants, GA_3 and Boron at 50 per cent flowering stages. These results are in conformity with those of Maradhi *et al*. (1989); Yadava and Sinha (1990) and Vippin Krishna *et al*. (2006a) in lucerne. The plant height did not vary significantly due to interaction of micronutrients and growth regulators. Basically plant height is a genetically controlled character, but several studies have indicated that plant height can either be increased or decreased by the application of synthetic plant growth regulators (Yadava and Sinha, 1990) in lucerne. Growth components are also influenced by micronutrients Vippin Krishna *et al*. (2006a) in lucerne.

Considerable amount of variability in number of branches per plant was exhibited by insect attractants, micronutrients and growth regulators sprayed at 50% flowering in lucerne. Spraying of insect attractants Bee-Q and the growth regulators GA_3 @ 50 ppm recorded significantly higher number of branches per plant during the experimentation.The treatment combinations of A_2M_1 (Bee-Q + Boron), A_2G_1 (Bee-Q + GA_3) and M_1G_1 (Boron + GA_3) recorded significantly higher number of branches per plant. Spraying of growth regulators Gibberilic Acid @ 50 ppm resulted in producing more number of branches which might have specialized plants for better utilizations of resources. Sharma *et al*. (1999) and Yadava *et al*. (1984) have also reported similar findings of higher number of branches per plant when crop was sprayed with micronutrients and growth regulators.

Number of flowers per plant at harvest varied significantly due to the application of insect attractants micronutrients and growth regulators. Application of Bee-Q attractant recorded higher number of flowers at harvest compared to Jaggery solution. This may be due to attraction of honey bees towards the commercial attractants has increased the pollination percentage and preventing the pre-mature drop of flowers. The spraying of Boron @ 0.8 per cent as foliar spray recorded significantly higher number of flowers per plant compared to Molybdenum @ 0.05 per cent application. Gibberilic Acid @ 50 ppm spray at the time of 50 per cent flowering produced significantly more number of flowers than the NAA @ 50 ppm. The probable reason might be the application of Boron and Gibberilic Acid resulted in the development of efficient photosynthetic structure which enables the plants to intercept higher quality of radiant energy resulting in greater development

TABLE 1
Influence of insect attractants, micronutrients and growth regulators on plant height, number of branches and number of flowers per plant at harvest in lucerne cv. RL-88

Treatment	Plant height (cm)	No. of branches/ plant	No. of flowers/ plant	No. of pods/ plant	Pod set %
Attractants (A)					
A_1	82.29	18.45	253	57.16	20.99
A_2	87.37	21.89	271	62.75	22.72
S. Em$\pm$	0.08	0.10	0.50	0.83	0.08
C. D. (P=0.05)	0.24	0.30	1.50	2.49	0.24
Micronutrients (M)					
M_1	84.98	20.15	263	60.43	21.96
M_2	84.67	20.20	261	59.48	21.75
S. Em$\pm$	0.08	0.50	0.50	0.15	0.03
C. D. (P=0.05)	0.24	NS	1.50	0.45	0.09
Growth Regulators (G)					
G_1	87.85	22.13	269	63.45	22.85
G_2	81.81	18.21	255	56.35	20.86
S. Em$\pm$	0.08	0.10	0.50	0.82	0.08
C. D. (P=0.05)	0.24	0.30	1.49	2.46	0.24
Interactions (A x M)					
A_1M_1	82.68	18.30	254	56.43	20.78
A_1M_2	81.91	18.61	252	57.90	21.20
A_2M_1	87.31	22.00	272	64.43	22.95
A_2M_2	87.43	21.78	270	61.06	22.50
S. Em$\pm$	0.12	0.13	0.70	1.17	0.11
C. D. (P=0.05)	0.36	0.36	0.21	NS	0.33
Interaction (A x G)					
A_1G_1	84.68	19.98	258	59.46	21.73
A_1G_2	79.91	16.93	249	54.76	20.25
A_2G_1	91.03	24.28	381	67.55	23.95
A_2G_2	83.71	19.50	261	57.93	21.48
S. Em$\pm$	0.12	0.13	0.70	1.6	0.12
C. D. (P=0.05)	0.36	0.39	0.20	NS	0.36
Interaction (M x G)					
M_1G_1	88.06	22.46	271	63.43	22.63
M_1G_2	81.96	17.83	255	57.40	21.10
M_2G_1	87.65	21.80	267	63.70	22.06
M_2G_2	81.70	18.60	255	55.26	20.63
S. Em$\pm$	0.12	0.12	0.70	1.17	0.11
C. D. (P=0.05)	NS	0.36	NS	NS	0.33
Interaction (A x M x G)					
$A_1M_1G_1$	84.62	20.26	260	58.33	21.07
$A_1M_1G_2$	80.73	16.33	249	54.53	20.50
$A_2M_1G_1$	84.73	19.70	255	60.80	22.40
$A_2M_1G_2$	79.10	17.53	249	55.00	20.00
$A_1M_2G_1$	91.50	24.66	283	68.53	24.20
$A_1M_2G_2$	83.13	19.33	261	60.33	21.70
$A_2M_2G_1$	90.56	23.90	280	66.60	23.73
$A_2M_2G_2$	84.30	19.66	260	55.53	21.26
S. Em$\pm$	0.17	0.19	1.00	1.66	0.17
C. D. (P=0.05)	0.51	NS	NS	NS	0.51

NS–Not Significant

Insect attractants (A)
A_1- Jaggery solution @ 2%
A_2- Commercial attractant (Bee-Q @ 0.175%)

Micronutrients (M)
M_1- Boron @ 0.8%
M_2- Molybdenum @ 0.05%

Growth regulators (G)
G_1- Gibberlic Acid (GA_3)@ 50 ppm
G_2- Naphthalene Acetic Acid (NAA) @ 50 ppm

of reproductive system. These results corroborate with the findings of Vippin Krishna *et al*. (2006a) in lucerne. The least number of flowers per plants was noticed with the treatment combinations of A_2M_2, A_1G_2 and M_2G_2 treatments. However, the treatment combination of all these did not vary significantly for number of flower production.

The remarkable increase in the reproductive characters may be due to proper translocations of sugar from vegetative to reproductive parts, mobilization of nutrients towards reproductive stage (Sherell, 1983) and increased number of bees visit (Elmstrom and Maymard, 1991).

Seed yield is a complex phenomenon; it is the manifestation of morphological, physiological and growth parameters. It is greatly influenced by external application of plant growth regulators (Dhaliwal and Bains, 1983), micronutrients (Hazra and Sinha, 1996) and insect attractants (Maynard *et al*., 1992).

The pod set percentage was significant due to insect attractants sprayed at the time of 50 flowering stage. Commercial Bee-Q insect attractant recorded significantly higher pod set percentage compared to Jaggery solution. In general, the pod set per cent was increased 5 to 6 per cent spraying by the commercial attractants over the Jaggery solution. The enhancement in pod set per cent was due to positive up thrust in activities of the plant and increased tripping caused by frequent visits of insects, pollen germination and pollen growth. These results of present investigation are in agreement with results of Yadava and Singh (1990) and Vippin Krishan *et al*. (2006b) in lucerne. The spraying of GA_3 at the time of 50 per cent flowering enhanced the pod set percentage compared to Naphthalene Acetic Acid treatments. Pod setting vary significantly due to the application of micronutrients at the time of 50% flowering. Spraying of Molybdenum recorded lower pod set per cent compared to Boron application. The great response of crop growth regulators has checked the shedding of flowers and directs the transport of metabolites towards the sink as evidence by increasing pod set per cent. These results are in agreement with those of Sundara (2002). The interaction effect between insect attractants, micronutrients and growth regulators exhibited significant variation on pod set per cent. The treatment combination of $A_1M_1G_1$ (Jaggery solution + Boron + GA_3) founds significantly superior over all other treatments combinations.

TABLE 2

Influence of insect attractants, micronutrients and growth regulators on number of seeds/pod, seed weight (gm)/plant, pod yield/plant (g) and seed yield (kg/ha) in lucerne cv. RL-88

Treatments	No. of seeds/ pod	Seed weight/ plant	Pod yield/ plant	Seed yield (kg/ha)
Attractants (A)				
A_1	4.86	1.53	12.74	227
A_2	6.01	2.83	14.75	268
S. Em$\pm$	0.12	0.02	0.35	0.81
C. D. (P=0.05)	0.36	0.06	1.05	8.43
Micronutrients (M)				
M_1	5.39	2.31	14.28	251
M_2	5.15	2.06	13.21	243
S. Em$\pm$	0.07	0.02	0.35	0.82
C. D. (P=0.05)	0.21	0.06	1.05	2.46
Growth Regulators (G)				
G_1	5.88	2.46	14.02	267
G_2	5.00	1.91	13.47	228
S. Em$\pm$	0.12	0.03	0.35	0.82
C. D. (P=0.05)	0.36	0.09	NS	2.46
Interaction (A x M)				
A_1M_1	4.73	1.41	12.37	219
A_1M_2	5.00	1.66	13.11	235
A_2M_1	5.91	3.20	16.20	268
A_2M_2	6.11	2.46	13.30	248
S. Em$\pm$	0.18	0.04	0.50	1.15
C. D. (P=0.05)	0.54	0.12	1.50	3.45
Interaction (A x G)				
A_1G_1	5.36	1.73	13.59	240
A_1G_2	4.36	1.34	11.89	214
A_2G_1	6.40	3.19	15.45	293
A_2G_2	5.63	3.47	14.06	253
S. Em$\pm$	0.18	0.03	0.50	1.16
C. D. (P=0.05)	NS	0.09	1.50	3.48
Interaction (M x G)				
M_1G_1	5.83	2.46	14.71	258
M_1G_2	4.81	2.16	13.86	239
M_2G_1	5.93	2.45	13.33	235
M_2G_2	5.18	1.65	13.09	228
S. Em$\pm$	0.18	0.03	0.50	1.15
C. D. (P=0.05)	NS	0.09	1.50	3.45
Interaction (A x M x G)				
$A_1M_1G_1$	5.13	1.54	13.32	243
$A_1M_1G_2$	4.33	1.29	11.42	215
$A_2M_1G_1$	5.60	1.90	13.86	257
$A_2M_1G_2$	4.40	1.40	12.36	213
$A_1M_2G_1$	6.53	3.38	16.10	294
$A_1M_2G_2$	5.30	3.03	16.30	273
$A_2M_2G_1$	6.26	3.00	12.80	223
$A_2M_2G_2$	5.96	1.91	13.81	252
S. Em$\pm$	0.25	0.05	0.71	1.63
C. D. (P=0.05)	NS	0.15	2.10	4.89

Spraying of Bee-Q recorded significantly more pods per plant (62.75) and higher pod yield per pant (14.75) as compared to Jaggery solution spray number of pods per plant (57.16) and pod yield per plant (12.74 g) respectively. The number of pods per pant and pod yield per plant varied significantly due to application of micronutrients. Higher number of pods and pod yield per plant was noticed in GA_3 sprayed plots when compared to Molybdenum. There were significant differences in number of pods per plant and pod yield per plant due to the application of growth regulators. GA_3 50 ppm sprayed at the time of 50 per cent flowering recorded higher pod yield per plant (14.02 g) as compared to NAA (13.47 g).

An increase in number of pods per plants and pod yield per plant may be due to more number of branches per plant and higher number of flowers per plant, decreased flower drop and increased pod setting. Similar results were reported Bahadhur and Singh (1990) in pea. Majumdar *et al*. (2001) in soybean and Meena *et al*. (2001) in chickpea.

The increase in pod weight per plant was due to higher number of seeds per pod, pods per plant and 1000 seed weight. These results are in agreement with findings of Saina and Thakur (1996) in pea.

The treatment combination of $A_1M_2G_1$ found significantly superior in producing number of pods per plant and pod weight per plant over all the other treatment combinations. The yield ultimately depends on the better expression of yield attributing characters.

Number of seeds per pod and seed weight per plant was significantly higher in the plots sprayed with Bee-Q insect attractants when compared to the Jaggery solution presented in Table 2. Number of seeds per pod and seed weight per plant differed significantly due to the application of micronutrients and growth regulators. The increase in number of seeds per plant, seed weight per plant and test weight might be due to better utilization of resources by the plant producing more number of flowers. The number of seeds per pod was higher in case of plots sprayed with GA_3 solution as this chemical is very much essential for proper development of seeds. GA_3 act as active sink and mobilize the photosynthates from the source to sink. This is also in confirmation with earlier reports of Manomani *et al*. (2002). The interaction effects for number of seeds per pod found non-significant, but significant for seed weight per plant. The treatment combinations of $A_1M_2G_1$ found significantly superior for all the yield attributing parameters over the other treatment combinations.

There was significant difference in seed yield per ha with application of insect attractants, micronutrients and growth regulators during the experimentation. Significantly higher seed yield per ha (268 kg) was noticed with flower application of Bee-Q when compared to Jaggery solution (227 kg) with the extent of 18% increase. Plots sprayed with Boron recorded maximum seed yield compared to the Molybdenum spray. Among the growth regulators, GA_3 @ 50 ppm recorded maximum seed yield when the crop was sprayed at 50 per cent flowering stage. The increase in the seed yields was due to multifarious factors. Seed yield is positively associated with number of pods per plant (Shinde *et al*., 1991), number of seeds per plant (Sinha, 1986), pod length (Durai Swamy and Mary, 2001) and pod yield per plant (Manomani *et al*., 2002). The enhancement in seed yield was due to auxin level which helps to promote fertilization and fruit setting. All the growth regulators and micronutrients treatments induced more number of pods per plant and pod yield per pant which in term helps to get maximum seed yield per ha. Interaction effects due to insect attractants, micronutrients and growth regulators seed yield per ha were found significant. The treatment combinations of A_2M_1 found significantly superior in producing higher seed yield. Spraying of Bee-Q attractants irrespective of micronutrients showed maximum seed yield. The treatment combination of $A_1M_2G_1$ found significant for seed yield over all the other treatment combinations.

REFERENCES

Anonymous, 2010, www.igfri.in/crop-profile-lucerne.htm.

Bahadur, V. and T. Singh., 1990: *Veg. Sci.*, **17** : 205-209

Dhaliwal, J. S. and D. S. Bains., 1983: *J. Punjab Agric. Univ.*, **20**: 241 - 250.

Duraisamy, P. and A. K. Mani., 2001: *Mysore J. Agric. Sci.*, **35**:26-31.

Elmstrom, G. W. and D. N. Maynard., 1991: Attraction of Honeybees 10th Bee attractant. *Proc. of the Florida state Hort. Univ.*, **103**: 130 - 133.

Gomez, K. A. and A. H. Gomez., 1984: *Statistical Procedures for Agricultural Research*, 2nd Edition. John Willey and Sons, New York.

Hazra, C. R. and N. C. Sinha., 1996: Forage seed production, A technological development published by South Asian Publishers Pvt. Ltd. New Delhi, pp. ll8-139.

Majumdar, B., M. S. Venkatesh., B. Lal., K. Kumar, and C. S.

Singh., 2001: *Annals Agric. Res.*, **22**: 354-359

Manomani, V., J. A. D. Ra, and A. Gopalan., 2002: *Seed. Tech. News.,* **32**(1): 34-35.

Maynard, D. N., G. W. Elmstrom, and F.T. Mc.Cuistien., 1992: Periodicity of Watermelon fruit set and Effect of bee attractants on yield. *Proc. of the Inter American Society for Topical Hort.,* **36**:81-87.

Meena, K. N., R. G. Pareek, and R. S. Jat., 2001: *Annals of Agric. Res.*, **22**: 388-390

Maradhi, M. J., J. Nagamoto, and V. Kopt, 1989, Report of Tokal Branch of Crop Sci. Sc., **03** : 7.

Saini, J. P. and S. R. Thakur., 1996: *Indian J. Agric. Sci*., **66**: 514-517

Sharma, S. K., H. Singh, and U. K. Kohl., 1999: *Seed Res*., **27**(1): 154-158.

Sherrell, C. G., 1983: *New Zealand J. Exp. Agric*., **11**(2): 113-1 17.

Shinde, A. K., B. M. Jamadagni, and S. P. Arid Birari., 1991: *J. Plant Physiol.,* **24**(4): 392-395.

Singh, R. P. and N. C. Sinha., 1988: Pasture and forage crops research - A state of knowledge report, 3rd *Int. Grassland Cong.,* pp. l39-l47.

Sinha, N. C., 1986: Annual Research Report, DIV of Plant Physiology and Biochemistry Punjab. Singh (Ed.), IGFRI Jhansi.

Sundara T. H., 2002: *M.Sc. (Agri) Thesis* submitted to Univ. Agric. Sci., Dharwad

Vippin Krishna., B. C. Channakeshava and K. P. Viswanatha., 2006a: *Forage Res.,* **32** (2):98-100.

Vippin Krishna, B.C. Channakeshava, K.P.R. Prasanna, and K. P. Viswanatha., 2006b: *Forage Res.,* **32** (3):152-154.

Yadava, R. B. R. and N. C. Sinha., 1990: *Seed Res.*,**18**(1): 182-186

Yadava, R. B. R., B. D. Patil, and O. P. S. Verma., 1984: *Seed Res.* **12**(1): 1- 18.