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Influence of insect attractants, micronutrients and growth regulators on growth and seed yield in lucerne (*Medicago sativa*)

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Lucerne (*Medicago sativa* L.) is popularly known as alfalfa, rightly called as Queen of forage crops in India, and considered as one of the important forage legumes, which normally lives 4-8 years, depending on variety and climate. It can be grown under wide range of soil conditions throughout the world. Among all the available forage legumes, lucerne is very ideal leguminous forage as it is highly palatable, nutritive, fast growing and it can be grown throughout the year. 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 full 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 of the major set back in lucerne, as it requires tripping mechanism for pollination (Hazra and Sinha 1996). 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. For many years the relationship of the controlling factors of alfalfa seed production was poorly understood so seed production failures were common and explanations are inconsistence.

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). Such substances are useful in agriculture because suitable concentration applied at appropriate time might increase the yield either by altering the dry matter distribution of the plants or by regulating the growth. In recent years, the micronutrients are gaining lot of momentum particularly in boosting the productivity and seed quality. The application of micronutrients brings profound changes in various metabolic processes within the plant systems thereby influences the yield and quality considerably. Keeping this in view, the present investigation was carried out with the objective to know the influence of insect attractants, micronutrients and growth regulators on seed production in lucerne.

The field experiment was conducted during *rabi* season of 2010-11 at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. 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- Gibberllic 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.

The soil was typical vertisol having available N of 265.0 kg/ha, P_2O_5 of 10.80 kg/ha and K_2O of 245.0 kg/ha and 7.5 pH. The experiment was laid out in randomized block design in factorial concept and replicated thrice. The dosage of fertilizers were applied as per the package of practice, i e 75 kg N, 60 kg P_2O_5 and 60 kg K_2O/ha in the form of urea, single super phosphate and muriate of potash, respectively. During the experimental period, the 535.10 mm rainfall was received with a mean maximum of 35.2°C and minimum temperature of 12.5°C and relative humidity ranged from 44 to 83%. The variety RL 88 used in this investigation is a perennial variety with good ratoonability and high fodder yielding ability for about 3-5 years with an average seed yield of 150 to 250 kg/ha.

All the insect attractants, micronutrients and growth regulators were sprayed at the time of 50% flowering stage

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Table 1 Influence of insect attractants, micronutrients and growth regulators on plant height, branches, flowers, pods/plant and pod set 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
SEm±	0.08	0.10	0.50	0.83	0.08
CD (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
SEm±	0.08	0.50	0.50	0.15	0.03
CD (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
SEm±	0.08	0.10	0.50	0.82	0.08
CD (P=0.05)	0.24	0.30	1.49	2.46	0.24
Interactions (A × 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
SEm±	0.12	0.13	0.70	1.17	0.11
CD (P=0.05)	0.36	0.36	0.21	NS	0.33
Interaction (A × 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
SEm±	0.12	0.13	0.70	1.6	0.12
CD (p=0.05)	0.36	0.39	0.20	NS	0.36
Interaction (M × 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
SEm±	0.12	0.12	0.70	1.17	0.11
CD (P=0.05)	NS	0.36	NS	NS	0.33
Interaction (A × M × 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
SEm±	0.17	0.19	1.00	1.66	0.17
CD (P=0.05)	0.51	NS	NS	NS	0.51

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

Table 2 Influence of insect attractants, micronutrients and growth regulators on plant height, number of seeds, seed wt., pod yield, seed yield and test weight in lucerne cv. RL 88

Treatment	No. of seeds/ pod	Seed weight (gm)/plant	Pod yield/ plant (g)	Seed yield (kg/ha)	Test weight (g)
Attractants (A)					
A_1	4.86	1.53	12.74	227	2.38
A_2	6.01	2.83	14.75	268	2.62
SEm±	0.12	0.02	0.35	0.81	0.01
CD (P=0.05)	0.36	0.06	1.05	8.43	0.03
Micronutrients (M)					
M_1	5.39	2.31	14.28	251	2.50
M_2	5.15	2.06	13.21	243	2.46
SEm±	0.07	0.02	0.35	0.82	0.01
CD (P=0.05)	0.21	0.06	1.05	2.46	0.03
Growth Regulators (G)					
G_1	5.88	2.46	14.02	267	2.60
G_2	5.00	1.91	13.47	228	2.41
SEm±	0.12	0.03	0.35	0.82	0.01
CD (P=0.05)	0.36	0.09	1.04	2.46	0.03
Interaction (A × M)					
A_1M_1	4.73	1.41	12.37	219	2.36
A_1M_2	5.00	1.66	13.11	235	2.41
A_2M_1	5.91	3.20	16.20	268	2.65
A_2M_2	6.11	2.46	13.30	248	2.60
SEm±	0.18	0.04	0.50	1.15	0.02
CD (P=0.05)	0.54	0.12	1.50	3.45	0.06
Interaction (A × G)					
A_1G_1	5.36	1.73	13.59	240	2.48
A_1G_2	4.36	1.34	11.89	214	2.29
A_2G_1	6.40	3.19	15.45	293	2.72
A_2G_2	5.63	3.47	14.06	253	2.53
SEm±	0.18	0.03	0.50	1.16	0.02
CD (P=0.05)	NS	0.09	1.50	3.48	0.06
Interaction (M × G)					
M_1G_1	5.83	2.46	14.71	258	2.59
M_1G_2	4.81	2.16	13.86	239	2.41
M_2G_1	5.93	2.45	13.33	235	2.61
M_2G_2	5.18	1.65	13.09	228	2.40
SEm±	0.18	0.03	0.50	1.15	0.02
CD (p=0.05)	NS	0.09	1.50	3.45	0.06
Interaction (A × M × G)					
$A_1M_1G_1$	5.13	1.54	13.32	243	2.46
$A_1M_1G_2$	4.33	1.29	11.42	215	2.26
$A_2M_1G_1$	5.60	1.90	13.86	257	2.50
$A_2M_1G_2$	4.40	1.40	12.36	213	2.32
$A_1M_2G_1$	6.53	3.38	16.10	294	2.73
$A_1M_2G_2$	5.30	3.03	16.30	273	2.57
$A_2M_2G_1$	6.26	3.00	12.80	223	2.72
$A_2M_2G_2$	5.96	1.91	13.81	252	2.48
SEm±	0.25	0.05	0.71	1.63	0.03
CD (P=0.05)	NS	0.15	2.10	4.89	0.09

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

on same day. The seeds were hand sown @ 10 kg/ha to the depth of 2-3 cm in the furrows spaced at 30 cm apart in all the plots. Observations on plant height, number of branches, number of flowers at harvest, percent pod setting, number of pods/plant, weight of the pod, number of seeds/pod, thousand seed weight, pod yield/plant, seed yield/plant and seed yield/ha were recorded. The data were statistically analyzed using MSTAT-C programme. The level of significance in F test was 5%.

The data showing the influence of insect attractants, micronutrients and growth regulators on plant growth in lucerne is presented in Table 1 and subsequently on seed yield parameters in Table 2. The plant height was significantly higher (87.37 cm) in Bee-Q commercial attractant, boron spray treatment (84.98 cm) and gibberellic acid treatments as compared to others. Among the combinations, A_2M_2 (Bee-Q + Molybdenum) and A_2G_1 found significantly superior in producing the higher plant height as compared to other treatment combinations. Higher plant height was noticed in plants sprayed with Bee-Q commercial attractant, GA_3 and boron at 50 % flowering stages. These results are in conformity with those of Vippin Krishna *et al*. (2006a) in lucerne. The plant height did not vary significantly due to interaction of micronutrients and growth regulators.

Spraying of insect attractants Bee-Q and the growth regulators GA_3 @ 50 ppm recorded significantly higher number of branches/plant. 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/plant. Spraying of growth regulators gibberellic acid @ 50 ppm resulted in producing more number of branches which might have specialized plants for better utilization of resources. Patel *et al.* (2003) have also reported similar findings of higher number of branches/plant when crop was sprayed with micronutrients and growth regulators. Application of Bee-Q attractant also 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 % as foliar spray recorded significantly higher number of flowers/plant compared to molybdenum @ 0.05% application. Gibberellic acid @ 50 ppm sprayed at the time of 50 % flowering produced significantly more number of flowers than the NAA @ 50 ppm (Table 1). These results corroborate with the findings of Vippin Krishna *et al*. (2006b) in lucerne.

In general, pod set per cent was increased by 5-6 % by spraying the commercial attractants over the jaggery solution. The enhancement 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. Among the micronutrients, the spraying of molybdenum recorded lower pod set per cent compared to boron application. The treatment combination of $A_1M_1G_1$ (Jaggery solution + boron + GA_3) found significantly superior over all other treatments combinations (Wen Hua Du *et al.* 2009).

Spraying of Bee-Q recorded significantly more pods/plant (62.75) and higher pod yield/pant (14.75) as compared to jaggery solution spray (57.16 number of pods/plant and 12.74g pod yield/plant, respectively). There were significant differences in number of pods/plant and pod yield/plant due to the application of growth regulators. GA_3 @ 50 ppm sprayed at the time of 50% flowering recorded higher pod yield/plant (14.02 g) as compared to NAA (13.47 g). An increase in number of pods/plant and pod yield/plant may be due to more number of branches/plant, higher number of flowers/plant, decreased flower drop and increased pod setting. Number of seeds/pod, seed weight/plant and 1 000 seed weight were significantly higher in the plots sprayed with Bee-Q insect attractants when compared to the jaggery solution (Table 2). The number of seeds/pod and 1 000 seed weight 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 Majumdar *et al.* (2001) and Manomani *et al* (2002). The treatment combinations of $A_1M_2G_1$ found significantly superior for all the yield attributing parameters over the other treatment combinations.

Significantly higher seed yield/ha (268 kg) was noticed with application of Bee-Q when compared to jaggery solution (227 kg) with the extent of 18% increase. Plots sprayed with boron and GA_3 @ 50 ppm recorded maximum seed yield. The enhancement in seed yield was due to auxin level which helps to promote fertilization and fruit setting. 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.

SUMMARY

Higher growth and seed yield of lucerne cv RL 88 can be produced with the application of insect attractants, micronutrients and growth regulators compared to the control. The present study thus clearly advocates the use of supplementary pollination chemicals, micronutrients and growth regulators to enhance the seed yield in lucerne.

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