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Effect of Growth Regulators on Flowering behaviour, Fruit setting and Yield of Soybean (*Glycine max* L.) Under Changing Scenario of Climate in North Western Himalayan

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Abstract: *The present investigation entitled, "Effect of growth regulators on flowering behavior, fruit setting and yield of Soybean (*Glycine max *L.) under changing scenario of climate in North Western Himalayan " was carried out involving ten treatments of growth regulators and* KNO_3 *with three replications. The pot experiment was conducted during* Kharif *season of 2015 in completely randomized block design (CRBD). Growth regulators used in this experiment were NAA (10, 20, 30 ppm), 2, 4-D (10, 20, 30 ppm) and* KNO_3 *(100, 200, 300 ppm). These growth regulators were applied as foliar application at bud initiation stage and 50 per cent flowering of the crop. All flowering parameters viz. number of flowers per plant, number of shed flowers and days to flowering were influenced by growth regulators and* KNO_3*. NAA - 20 ppm was superior to all treatments of NAA, 2, 4-D and* KNO_3*. Maximum numbers of flowers per plant (85.6) at 100 per cent flowering were observed in NAA 20 ppm. Early flowering (After 50 days of sowing) and minimum number of shed flowers (11.7) were also noted in NAA 20 ppm at 100 per cent flowering. The highest yield and yield contributing character were recorded in NAA -20 ppm.*

INTRODUCTION

Soybean (*Glycine max* L.) is the leading oil seed crop of the world in terms of both area and production. In the recent years, Soybean has become an important crop in India since it yields oil, protein and also other industrial products yielding crop. Growth regulators are reported to have an effect on morphological parameters of soybean (Senthil, 2003). Yield potential of pulses is greatly affected by non-leaf synchronous habit, flower drop, nodule disintegration at the time of flowering, heavy senescence at the time of pod development, excessive vegetative growth in response to excessive irrigation and less fruit setting in lower branches of the plant (Sinha, 1974; Chaturvedi *et al.*, 1980). Growth regulators are effective in several crops and found to balance the source and sink relationship, leading to increase in the yield of crops (Cheema *et al.*, 1987). Plant growth regulators are found to enhance growth and physiological activity of the plant (Reena *et al.*, 1998).

Exogenous application of growth regulators is one approach to improve crop productivity (Pando and Srivastava, 1985). Plant growth regulators play an important role in circumventing limitation to improve production. According to Basole *et al.* (2003) the yield of soybean can be enhanced through physiological growth manipulation by way of foliar application of growth regulators like NAA and nutrients like KNO_3, $ZnSO_4$. The foliar application of nutrients and hormones to certain extent can help in making available the required nutrients to crop for optimum growth and productivity under adverse conditions of soil. The pulse and oil seed crop yields are very poor and this discourages the wide cultivation of it. The plant normally produces large number of flowers but most of them abscise and fruit setting is controlled by many factors. So the use of growth regulators proved better to increase the yield. In the present experiment the effect of growth regulators NAA, 2, 4-D and

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nutrient KNO_3 were investigated on flower drop ,fruit setting and yield of Soybean *(Glycine max* L.) under mid hill conditions Uttarakhand during kharif season 2015 .

MATERIALS AND METHODS

The pot experiment was conducted to see the "Effect of growth regulators on flowering behaviour, fruit setting and yield of Soybean (*Glycine max* L.) under changing scenario of climate in North Western Himalayan'' during kharif season 2015. The pot experiment was laid out in Complete Randomized Design with three replication. The experimental variable consisted of ten treatments having one main crop of Soybean as control (T_1-control, T_2-NAA-10 ppm, T_3-NAA-20 ppm, T_4-NAA-30 ppm, T_5-2-4-D-10 ppm, T_6—2-4-D-20 ppm, T_7-2-4-D-30 ppm, T_8- KNO_3-100 ppm, T_9-KNO_3-200 ppm, T_{10}-KNO_3-300 ppm.

The pot soil in the ratio of 20:40:40 was fertilized with nutrients like N: P: K. The variety Pant Soybean-1092 (*Glycine max L.)* was used in this experiment. The plant was sprayed with different concentrations of growth regulators about one week earlier to bud initiation. The second spraying was done at the stage of 50 percent flowering. The number of flowers/plant were counted after 5 days of first and second spray of bio regulators.

The yield and yield contributing characters were recorded after harvesting of the crop. Samples comprising of 1000 grains were drawn irrespective of shape and size from the produce of each pot and weight. Weight of 1000 grains was recorded. The total seed yield was separately weighted (g/plant) to obtain the grain yield per plant.

RESULTS AND DISCUSSION

Table 1 shows that early flowering was achieved by the application of growth regulators. The treatment 20 ppm (T_3) of NAA hastened the flowering effectively as compared to other treatments followed by 10 (T_2) and 30 ppm (T_4) of NAA. These NAA treatments were in turn followed by 2, 4-D - 20 (T_6), 10 (T_5) and 30 ppm (T_7) and KNO_3-200 (T_9), 100 (T_8) and 300 ppm (T_{10}). Maximum days to 50 and 100 per cent flowering were observed in control. Upadhyay, (2002) observed the same findings with the application of NAA @ 20 ppm which showed significant early flowering over control. Earliness of flowering is desirable feature to escape lower temperature at the time of maximum flowering. The results are supported by Leport *et al* (1999) who suggested that early flowering would benefit yield if flowers were fertile, leading to early pod development and seed filling and thus, avoiding terminal soil moisture stress as in the case of chilling tolerant genotypes.

Table 1
Effect of NAA, 2-4-D and KNO_3 on flowering, fruit setting and yield of Soybean

Treatment	*Days to 50% flowering*	*Days to 100% flowering*	*Number of flowers at 50% flowering*	*Number of flowers at 100% flowering*	*Number of shed flowers at 100% flowering*	*Test weight (g/plant)*	*Grain yield (g/plant)*	*Biological yield (g/plant)*
T_1 (Control)	53.67	60.11	35.0	55.8	27.0	131.81	12.21	35.62
T_2 (NAA 10 ppm)	50.38	55.55	44.2	77.0	16.0	168.91	22.67	48.37
T_3 (NAA 20 ppm)	49.00	54.00	49.0	85.6	11.7	176.77	24.84	50.70
T_4 (NAA 30 ppm)	50.90	56.00	42.2	75.5	19.0	166.47	21.62	45.28
T_5 (2, 4-D 10 ppm)	51.21	56.08	40.4	72.6	18.1	164.87	20.33	42.96
T_6 (2, 4-D 20 ppm)	51.00	55.90	41.3	75.0	17.6	165.19	21.19	45.12
T_7 (2, 4-D 30 ppm)	51.66	57.33	40.0	70..0	19.5	161.37	19.20	41.43
T_8 (KNO_3 100 ppm)	52.00	58.66	39.5	65.0	23.8	145.69	15.63	40.69
T_9 (KNO_3 200 ppm)	51.00	57.30	39.9	69.0	23.0	148.69	18.62	42.82
T_{10} (KNO_3 300ppm)	52.50	59.00	39.1	63.0	21.2	143.57	14.60	38.41
CD at 5%	0.77	0.97	0.6	1.8	0.7	1.152	0.47	0.51

It is revealed from the Table 1, that number of flowers at 50 and 100 per cent flowering increased significantly by the application of growth regulators and KNO_3 as compared to control. Highest numbers of flowers were observed in pots treated with NAA–20 ppm (T_3) at 50 and 100 per cent flowering, respectively, while lowest numbers of flowers were obtained with control at 50 and 100 per cent flowering respectively. With respect to increase in number of flowers per plant, highest number were obtained in NAA treatments followed by 2, 4-D and KNO_3 treatments. They found that the foliar application of NAA (20 ppm) had significantly increased the total number of flowers formed per plant (75%) as compared to unsprayed plants.

Number of shed flowers at 100 per cent flowering were minimum in pots treated with NAA -20 ppm followed by 10 ppm of NAA (Table 2). Number of shed flowers were same in treatments NAA with 30 ppm concentration and 2, 4-D with 30 ppm concentration. Maximum flowers shedding were observed in control. Similar results were recorded by Upadhyay, 1994 that NAA prevents flower drop by preventing the formation of the abscission layer. Effectiveness of NAA to check the flower drop may be due to creation of favorable balance of endogenous hormone relative to flowering which inhibits abscission accelerating enzymes like cellulases, succinic dehdrogenases, RNAase, Malic dehydrogenases etc, Auxin induced nucleic acid synthesis to create better reproductive structure (Moore, 1980 and Addicot,1977)

It is evident from the observations presented in the table 1 that the marked improvement was brought towards the test weight of soybean due to influence of growth regulators. The significantly highest 1000 grain weight was recorded in the concentration of NAA-20 ppm followed by its remaining concentrations of 10 and 30 ppm which in turn were followed by all the concentration of 2, 4-D and KNO_3. Among treatment, lowest test weight was observed in control.

Economic yield markedly increased with the treatments of growth regulators (Table 1). The significantly highest grain yield was recorded in NAA 20 ppm while lowest was observed in control. The significantly highest grain yield were recorded in NAA (20, 10 and 30 ppm) followed by 2, 4-D (20, 10 and 30 ppm) and KNO_3 (200, 100 and 300 ppm) treatments, respectively.

It is evident from the mean values in table 1 that marked improvement was brought towards biological yield of Soybean due to influence of growth regulators. Maximum biological yield was obtained in pot treated with NAA concentration of 20 ppm followed by 10 and 30 ppm concentration of the same growth regulator which in turn were followed by 2,4-D (20,10 and 30 ppm) and KNO_3 (200, 100 and 300 ppm) respectively. Minimum biological yield was observed in control. Thus form the above observations it appears that highest biological yield was recorded with all NAA treatments followed by 2,4-D treatments and KNO_3 Treatments.

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