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EFFECT OF KNO_3, VITAMIN B_6 AND SALICYLIC ACID ON GROWTH, FALSE SILIQUA FORMATION AND SEED YIELD IN TORIA

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SUMMARY

In a field trial, the effects of foliar spray of $KN0_3$ (5000, 10000, 15000 and 20000 ppm), vitamin B_6 (0.05, 0.10, 0.15 and 0.20 ppm) and salicylic acid (10, 100, 500 and 1000 ppm) were assessed on growth, false siliqua formation and yield components in toria (*Brassica campestris* L.). Application of all chemicals influenced plant height, branching, days to flower initiation, days to 50% flowering, days to maturity and percentage of false siliqua formation. Among all treatments, 15000 ppm of $KN0_3$, was found superior over rest of the treatments in improving the morphological traits, yield components and yield potential of toria.

***Key words*: False siliqua, flowering behaviour, $KN0_3$, pyridoxine, salicylic acid, toria.**

INTRODUCTION

Rate of supply of carbon assimilates to the developing flowers and siliqua are very important, throughout, in regulating the size of different yield components. This is evident from the correlation between leaf area index, siliqua numbers and seed number per siliqua (Allen and Morgan 1975). The reduction in siliqua number, seed number per siliqua and weight per siliqua was observed following shedding of leaves from anthesis onwards (Tayo and Morgan 1979). Photosynthesis in leaves, stem and siliqua and the size of these organs are important determinants of seed yield (Morgan 1982). It is in this context an effort was made to manipulate the yield components and yield through exogenous application of certain chemicals. Since, the productivity of toria and mustard in Assam is far below the national average as they are grown on marginal lands under rainfed conditions with or without very little use of fertilizers leading to poor grain set and high false siliqua formation.

In recent years, number of chemicals are directly sprayed on foliage of the crop plants, because, they are readily absorbed and utilized more efficiently than soil application. This is particularly true in case of annual fast growing crops within specific periods. Foliar application of KNO_3, vitamin B_6 and salicylic acid involve in number of physiochemical changes, which lead to change the flowering behaviour and growth parameters and ultimately increase the yield of the crops. Mathur (1997) observed that pyridoxine application at 0.1 % in *Brassica juncea* promoted growth and development of fruiting structures by enhancing the reproductive efficiency, delayed the process associated with pod senescence due to its antisenescence property and increased the photosynthetic efficiency without influencing the length of reproductive period. Mathur (1997) also observed that foliar application of pyridoxine increased NR activity and chlorophyll content. Salicylic acid increased the pod number in mungbean (Singh and Kaur 1980) and increased the height and grain number of Cheena millet

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(*Panicum miliaceum*) (Dutta and Nanda 1985). Laughlin (1962) found that foliar spray of 1 % solution of K salts practically eliminated leaf breakdown and greatly increased tuber yield in potato. Chandra (2005) also found an increase in cane yield and sugar content in sugarcane with 2% KNO_3 solution treated plants over control. Foliar application of KNO_3 and KCl led to improvement of the content of starch and raw protein as compared to control in potato and sugar beet crops (Nigrilla *et al.* 1994). K application is responsible for translocation of photosynthates from different plant parts to the seat of accumulation (Mengel and Krikby 1980). Interaction of N and K during formative phases and seedfilling stages give higher yield (Majumder *et al.* 1988). Moreover, there is not much information available regarding the role of these chemicals on flowering behaviour and growth pattern in toria under rainfed ecosystem. Keeping the above in mind, the present study was undertaken to sort out the most efficient chemical and its concentration which can improve the growth efficiency, flowering behaviour and reduce the false siliqua formation under rainfed conditions of Jorhat (Assam).

MATERIALS AND METHOD

A trial was conducted during rabi season in 1998-99 in instructional-cum-research farm, Department of Crop Physiology, Assam Agricultural University, Jorhat. The crop was sown on 9th November. Plant to plant spacing was maintained at 30 cm between rows and 10 cm within row. There were 14 treatments comprised of KNO_3 (5000, 10000, 15000 and 20000 ppm), vitamin B_6 (0.05, 0.10, 0.15 and 0.20 ppm) and salicylic acid (10, 100, 500 and 1000 ppm) including two controls with and without water treatment, respectively. The foliar treatment was done twice, once at 15 days after sowing and another at 50% flowering stage (30 DAS). All treatments were replicated three times in a randomized block design. The soil of the experimental site was sandy loam with pH 5.4, low in available nitrogen (244.2 kg/ha), phosphorus (20.7 kg/ha) and potassium (52.4 kg/ha). The fertilizers doses of 40 kg N (as urea), 35 kg P_2O_5 (as single super phosphate) and 15 kg K_2O (as muriate of potash) per hectare were mixed together and applied to experimental area along with 10 kg borax per hectare. Plants having uniforms growth were randomly selected within one square meter area at the center of each plot and marked for various observations. The data were statistically analysed by analysis of variance (ANOVA).

RESULTS AND DISCUSSION

A significant difference in plant height at various growth stages among the applied chemicals was observed (Fig. 1). The maximum plant height 37.3 cm, 85.7 cm and 100.6 cm was recorded with KNO_3 (20000 ppm) at 30, 60, and 90 days after sowing respectively. While the same was found lowest 25.2 cm, 67.7 cm and 76.4 cm with salicylic acid (1000 ppm) at the aforesaid stages of crop growth, respectively. With the increasing concentration of salicylic acid there was drastic reduction in plant height at successive stages of crop growth with maximum reduction at 1000 ppm. These results are in close conformity with the findings of Patra *et al.* (1995), who reported that application of KNO_3 and urea increased the plant height over control in groundnut. Whereas salicylic acid reduced the plant height with increasing concentration. Similar results were also observed by Patil (1993) in groundnut.

Fig. 1. Effect of KNO_3, pyridoxine and salicylic acid on plant height at various growth stages

An increasing trend in number of primary branches at various growth stages over control (Fig. 2) was noticed with the applied treatments. The highest 4.19, 5.83 and 6.39 number of primary branches were recorded with KNO_3 (15000 ppm) at 30, 60 and 90 DAS, respectively. However, salicylic acid treated plants showed reduction in branching per plant with increased concentration. Pyridoxine (0.2 ppm) significantly increased the number of primary branches, which were at par with KNO_3

Fig. 2. Effect of KNO_3, vitamin B_6 and salicylic acid on number of primary branches at various growth stages

Fig. 3. Effect of KNO_3, vitamin B_6 and salicylic acid on days to first flower initiation, days to 50% flowering and days to maturity

(15000 ppm) and pyridoxine (0.15 ppm). The increase in number of primary branches per plant as a result of foliar application of the applied chemicals appeared to be due to better translocation and utilization of photosynthates. These results are in close confirmation with the findings of Patra *et al.* (1995) and Kodandaramiah and Rao (1984) with Indian mustard.

The salicylic acid treated plants took less time for first flower initiation in comparison to other chemicals applied in this study (Fig. 3). However, salicylic acid 10 and 100 ppm were at par each other which took minimum 26 days for first flower initiation while maximum 30 days time taken for first flower initiation was recorded with water treated plants. As regard, days taken to 50% flowering, it differed significantly among the applied chemicals (Fig. 3). Salicylic acid (100 ppm) treated plants took minimum 38 days for their 50% flowering as compared to the plants treated with salicylic acid, 10 ppm. Similarly KNO_3 (5000 ppm) and salicylic acid (500 ppm) were at par with each other, which took 39 days for their 50% flowering. Moreover, salicylic acid 100 ppm treated plants matured earlier as compared to other chemicals which took 88 days for its maturity, followed by salicylic acid 10 ppm (91 days), KNO_3, 15000 ppm (91days) and KNO_3, 10000 ppm (92 days) treated plants. Further, rest of the treatments such as pyridoxine (0.05, 0.10, 0.15 and 0.20 ppm) and KNO_3, (20000 and 5000 ppm) showed intermediate effect but were significantly superior over control in respect of days taken to maturity (Fig. 3). These results are in close conformity with the finding of Kumar and Nanda (1981). According to them the effect of salicylic acid on the timing of flower bud initiation and the formation of total number of flower buds per plant was synergistic to the GA effect and was accompanied by increase in total RNA content, phosphatase and some non identified proteins in the vegetative organs of treated plants. The mechanism by which salicylic acid induced flowering in plants is not known but one hypothesis suggests that salicylic acid induce flowering by acting as a chelating agent (Oota 1975), because the free hydroxyl group confers metal chelating activity to benzoic acid. This view is supported by the fact that chelating agents can induce flowering in leomnaceae (Oota 1972). Foliar application of pyridoxine delaying the process of senescence without influencing the length of reproductive period has also been reported (Mathur 1997).

Significant differences are observed in the effect of applied chemicals on number of flowers and siliqua per plants at reproductive phase (Table 1). The highest number of flowers 202.3 and siliqua (104.1) per plant were recorded with KNO_3 ppm concentration, whereas the lowest 59.3 siliqua per plant was noticed in salicylic acid 1000 ppm treated plants. KNO_3 prevents premature flower drop and thereby retain more number of flowers and pods and increase yield of cotton (Synder *et al.* 1995). Similar results were also reported by Mathur (1997), who observed that foliar application of pyridoxine retained maximum number of flowers and pods by preventing the premature abscission of flowers and young pods of *Brassica* and improved the yield at maturity. The highest seed yield (12.98 q/ha) was obtained with KNO_3,

Table 1. Effect of KNO_3, pyridoxine (Vit. B_6) and salicylic acid on number of flowers, number of siliqua formed per plant, false siliqua formation, grains/siliqua, seed yield at maturity and per cent increase of grain yield over control in toria.

Treatment and concentration	Number of flowers per plant	False siliqua formation (%)	Number of siliqua formed per plant	Grain/ siliqua	Seed yield (q/ha)	Increase in yield over control (%)
KNO_3 (5000 ppm)	188.57	11.58	89.38	15.18	12.65	21.05
KNO_3 (10000 ppm)	202.31	11.09	104.17	15.92	12.93	23.73
KNO_3 (15000 ppm)	200.56	10.47	98.97	16.19	12.98	24.21
KNO_3 (20000 ppm)	193.17	11.55	98.39	15.97	12.75	22.01
Pyridoxine (0.05 ppm)	178.24	14.22	80.20	15.07	11.60	11.00
Pyridoxine (0.10 ppm)	184.32	13.75	86.54	14.12	11.75	12.40
Pyridoxine (0.15 ppm)	184.83	12.52	89.26	14.95	11.98	14.64
Pyridoxine (0.20 ppm)	192.54	11.95	94.85	15.08	12.38	18.47
Salicylic acid (10 ppm)	193.27	12.12	91.79	14.97	12.12	15.98
Salicylic acid (100 ppm)	188.07	12.88	86.67	14.85	11.88	13.69
Salicylic acid (500 ppm)	182.25	14.75	85.74	13.08	11.21	7.27
Salicylic acid (1000 ppm)	142.09	16.37	59.33	10.12	10.21	(-) 2.29
Water spray						
(No chemical treatment)	178.04	15.78	69.18	13.92	11.15	6.69
Control (No treatment)	142.32	16.02	68.44	12.93	10.45	-
SEd	3.87	0.0476	4.24	0.047	0.0308	-
CD for treatment (P=0.05)	7.96	0.0980	8.72	0.0968	0.095	-
CD for treatment (P=0.01)	10.76	0.1326	11.79	0.1309	0.126	-
CV (%)	2.60	0.442	6.05	0.411	0.4510	-

15000 ppm treated plants while it was lowest (10.21 q/ ha) with salicylic acid, 1000 ppm concentration (Table 1). The rest of the concentrations of salicylic acid significantly increased the seed yield over control. It is evident that the lowest (10.47%) false siliqua formation was recorded with KNO_3, 15000 ppm while the highest (16.37%) false siliqua per plant was found with salicylic acid 1000 treated plants. Likewise, there was increase in grain siliqua with all the applied chemicals except salicylic acid, 1000 ppm over control. The highest number of grain/siliqua was obtained with KNO_3, 15000 ppm concentration while the lowest seeds/siliqua was obtained with salicylic acid, 1000 ppm. The increase in number of siliqua per plant was mainly due to the increased number of primary and secondary branches as well as siliqua setting and reduced abscission of reproductive parts *viz*. number of flower and siliqua as observed in the present study. This is in close conformity with the findings of Zaman (1988), Patel (1994), Shukla and Kumar (1992) in number of crops like, sunflower, green gram and mustard.

In conclusion, among the various chemicals KNO_3 (15000 ppm) was found to be the most effective and promising in improving the morphophysiological traits such as plant height, number of primary and secondary

branches and productivity potential in terms of number of flowers, siliqua per plant, grains per siliqua, reduction of false siliqua formation and ultimately more seed yield. The per cent increase of yield of toria with same treatment was 24.2% over control under agro-climatic condition of Assam.

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