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INFLUENCE OF GROWTH REGULATORS ON GROWTH, YIELD AND ECONOMICS OF CABBAGE VARIETIES

BIRENDRA VIKRAM SINGH

Department of Horticulture, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior – 474 002 (M.P.), India
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ABSTRACT

A field experiment was conducted at Gwalior during rabi season of 2012-13 to study the effect of mixture of GA and NAA with four concentrations i.e. 0, 10, 15 and 20 ppm on growth, yield attributes and yield on cabbage varieties, namely Krishna (Hybrid), Kranti (Hybrid), Golden acre and Pride of India. Results revealed that 15 ppm GA_3 + NAA was found most effective growth regulator in increasing the growth, yield attributes and head yield (688.50 q ha^{-1}) and net returns (₹. 1,05,792 ha^{-1}) of cabbage varieties. Among varieties, Krishna (Hybrid) produced the maximum growth, yield (625.35 q ha^{-1}) and net return (₹.93893 ha^{-1}) as compared to the other varieties. Pride of India proved inferior in respect of growth, yield and net returns.

Key words: Growth regulators, cabbage varieties, productivity, economics

INTRODUCTION

Cabbage (*Brassica oleraceae* var. Capitata Linn.) belongs to family Cruciferae is an important vegetable of cole group. It is one of the important vegetable crops cultivated throughout India. It is very nutritional and a rich source of vitamin A, B, C also contains protein upto 1.4 g/100 g. Cabbage is used as vegetables in curries, salad and pickling. It is used alone or mixed with potatoes for vegetable purpose. It covers about 6% of total area under vegetables. India comes next to China in cabbage production occupying an area of 0.28 million hectares with the production of 6.20 million tonnes. In the recent years, the use of growth regulators in improvement of quality and yield of vegetable has been emphasized. Gibberellic acid (GA) is a very potent plant growth substance and its application at very low concentrations can have a profound effect. Application of NAA induces higher physiological efficiency including photosynthetic ability of plants. It leads to better growth and yield of several vegetable crops without substantial increase in the cot of production (Shivran and Jat 2013; Verma and Maurya 2013). Information regarding the use of plant growth regulators on cabbage is not available. Hence, an attempt was therefore made to identify the growth regulators and their varying concentration for obtaining the maximum significant results of cabbage varieties.

MATERIALS AND METHODS

The field experiment was conducted at the Horticulture nursery, College of Agriculture, Gwalior (M.P.) during the *rabi* seasons of 2012-13. Gwalior is situated in the northern tract of M.P., enjoying sub-tropical climate with extreme hot about 46^0 C in summer and minimum temperature 1^0 C in the winter season. It is located at the latitude of $26^013'$ N longitude $74^0 4'$E and altitude of 208 m above the sea level. The field soil was sandy-loam having soil pH 7.9, electrical conductivity 0.13 dSm^{-1}, organic carbon 4.7 g kg^{-1}, available N, P_2O_5 and K_2O 214, 15 and 283 kg ha^{-1}, respectively. Mixtures of GA and NAA with their four concentrations (0, 10, 15 and 20 ppm) were tested in randomized block design (factorial) with three replication and four varieties namely Krishna (Hybrid), Kranti (Hybrid), Golden acre and Pride of India. The seeds of different varieties of cabbage were treated treatmentwise by hormonal powder of GA_3+NAA at their varying concentrations before sowing in nursery bed. The recommended doses of fertilizers nitrogen 150 kg ha^{-1}, P_2O_5 80 kg ha^{-1} and 75 kg K_2O ha^{-1} were applied through urea, single superphosphate and muriate of potash, respectively as basal dressing two days prior to transplanting. In addition to these fertilizers, a basal dose of 200 q ha^{-1} of FYM was also incorporated at the time of field preparation and plant protection measures were adopted for optimum crop growth. Observations were recorded on plant height (cm), number of open leaves/plant, length and width of leaves, circumference of head, weight of untrimmed and trimmed head, stalk length, diameter of head and yield of head. The observations on the characters of growth and development of plants were recorded at 75 DAT on five randomly selected plants from each treatment in each replication. The data

were analysed by adopting the standard procedures. Several economics indices are available to evaluate the profitability of cropping system. No single index is capable of giving good comparison of different treatment and so a number of index of indices are used together to assess the economic viability of the system. Since, the price of the farm products changes from year to year, season to season and place to place, the profitability of the system also changes accordingly. Gross income, net return and B:C ratio for the treatments were calculated by using standard basic formulae of economics.

RESULTS AND DISCUSSION

Growth parameters

Growth parameters as affected by various treatments are presented in Table 1. Results revealed that Krishna (Hybrid) recorded maximum plant height (22.06 cm) and length of leaves upto 31.04 cm, whereas Golden acre resulted in the highest number of open leaves (19.02/plant). Krishna (Hybrid), Golden acre and Pride of India recorded more or less equally higher leaf width (27.08 - 27.14 cm), whereas the lowest leaf width (23.28 cm) was measured in Kranti (Hybrid). The Pride of India recorded the significantly lowest leaf length (23.48 cm) over other three varieties (Table 1). Thus, there appeared to be very wide differences among these four cabbage varieties with respect to vegetative growth characters. This may be due to variation in the genetical variability among the varieties against growth characters as well as due to changes in the agro-climatic conditions. The similar variations in growth characters among the cabbage varieties have also been reported by Patil and Patil (1997) and Shaikh *et al.* (2002). This reason may be due to the fact that the increased vegetative growth of the plant gives more opportunity for photosynthesis area resulted higher rate of photosynthesis and accumulation of food material sink. Increasing the concentrations of plant growth substances only upto 15 ppm increased all the growth characters almost significantly (Table 1). Further increase in concentration upto 20 ppm did not increase these parameters over 15 ppm concentrations. Enhancement in morphological parameters by the mixture of GA3 and NAA may be due to their affect on cell enlargement, cell growth, physico-chemical properties of protoplasm, respiration, nitrogen and nucleic acid metabolism etc. NAA promoted cell division in pericycle and cortical tissues, the pattern was similar as occurring during lateral root development. The evidence finds support of the mechanism of auxin action in terms of master reaction theory of Thiamann (1936) as quoted by Khamparia (1998) that auxin is held responsible for initiating a fundamental change in the enzyme system of cytoplasm. The beneficial influence of plant growth regulators on growth parameters of horticultural crops have also been reported by Singh *et al.* (2001) and Kanaujia et al. (2002).This is possibly due to the fact that plant growth regulators encourages the cell division and elongation with the modification of physiological processes resulted in enhancement of growth characters in cabbage varieties.

Table 1: Growth and yield-attributes of cabbage varieties as influenced with mixture of GA3 + NAA concentration

Treaments	Plant height (cm)	No. of open leaves /plant	Length of leaves (cm)	Width of leaves (cm)	Circumference of curds (cm)	Weight of untrimmed curds (kg)	Weight of trimmed curds (kg)	Stalk length (cm)	Diameter of curd (cm)
Varieties									
Krishna (Hybrid)	22.06	17.51	31.04	27.08	26.47	2.44	1.85	10.95	5.20
Kranti (Hybrid)	18.32	17.13	26.06	23.38	23.22	2.35	1.75	10.35	4.68
Golden acre	18.86	19.02	24.73	27.00	33.56	1.54	1.08	10.28	6.29
Pride of India	18.43	17.49	23.48	27.14	14.26	1.16	0.76	10.15	2.32
CD(P=0.05)	0.65	0.43	0.60	0.70	1.27	0.15	0.13	0.22	0.21
GA3 + NAA (ppm)									
0	18.53	16.87	25.07	24.33	21.43	1.48	1.02	9.67	3.39
10	19.05	17.38	26.02	26.59	23.42	1.98	1.46	9.73	3.72
15	19.77	18.07	26.85	27.11	25.86	2.50	1.55	9.93	4.12
20	19.25	17.91	26.41	26.68	25.61	1.92	1.50	9.85	4.07
CD(P=0.05)	0.65	0.43	0.60	0.70	1.27	0.15	0.13	0.22	0.21
Interactions	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.

Sig. - Significant

Yield-attributes

The productivity of any crop is totally based on the yield-attributing parameters. In case of cabbage, the yield attributes were circumference, diameter, weight of untrimmed and trimmed head. The head of Golden acre attained significantly higher

circumference (33.56 cm) as well as diameter (6.29 cm) over the varieties taken in the treatments. So far, whatever the weight of untrimmed and trimmed heads was concerned it was found lowest i.e. 1.54 and 1.08 kg respectively. However, Krishna (Hybrid) variety, all the above mentioned yield-attributes were found in the higher range. On the other hand, the variety Pride of India recorded all the four yield-attributes in the significantly lowest range (Table-1). The significant variations among the varieties with respect to yield-attributes may be due to similar positive variations recorded in case of the growth attributes of cabbage varieties. These variations may be due to the effect of prevailing environmental conditions. The photosynthesis, respiration and other metabolic processes vary due to the environmental fluctuations from variety to variety. Some varieties respond positively while other negatively. The differences noted in the four varieties viz. Krishna (Hybrid), Kranti (Hybrid), Golden acre and Pride of India may be due to these reasons under the agro-climatic conditions of Kymore plateau. Abu Grab and Ebrahim (2010) also reported similar results. In regards to plant growth substances only 15 ppm enhanced the yield-attributes significantly (Table-1). The significant increase in yield-attributes due to PGS mixture may be due to the significant increase in plant height, number of open leaves/plants, length and width of leaf. Considerably, PGS can only modify the attributes corroborating to the findings of researchers (Anand Bahadur, 2001 and Singh et al., 2003). The probable reason may be due to application of PGS mixture in minute quantities for growth and development of plants. GA3 + NAA accelerate the development of growth and reproductive phases thus, promoting yield attributing characters.

Table 2: Yield and net returns from cabbage varieties as influenced with mixture of GA3 + NAA concentration

Treatments	Yield of untrimmed curds (q ha^{-1})	Yield of trimmed curds (q ha^{-1})	Gross income (₹. ha^{-1})	Net returns (₹. ha^{-1})	B:C ratio
Varieties					
Krishna (Hybrid)	885.73	625.35	137700	93893	4.31
Kranti (Hybrid)	887.00	598.91	136000	89340	4.12
Golden acre	584.16	370.66	130534	43345	2.55
Pride of India	402.75	281.97	125800	26333	1.94
CD(P=0.05)	58.20	43.28	--	--	--
GA3 + NAA (ppm)					
0	593.23	388.06	96050	48624	2.67
10	691.58	475.58	102632	65221	3.27
15	743.83	688.50	105792	70714	3.51
20	731.00	503.50	100086	68352	3.46
CD(P=0.05)	58.20	43.28	--	--	--
Interactions	Sig.	Sig.	--	--	--

Sig. - Significant

Yield and net returns

The data (Table 2) indicate that the variety, Krishna (Hybrid) proved the best giving maximum yield of trimmed heads (625.35 q ha^{-1}) followed by Kranti (Hybrid) producing 598.91 q ha^{-1} trimmed heads. The differences in cabbage yield from different varieties are exactly in accordance with the yield-attributes obtained in these varieties as a result of attainment of genetically governed yielding potentiality. These findings are in conformity with the findings of Patil and Patil (1997); Abu Grab and Ebrahim (2010) and Singh *et al.* (2003) who reported that yield attributes were significantly influenced due to curtailed vegetative growth with the encouragement of reproductive phase. The increasing concentration of plant growth regulators mixture only up to 15 ppm proved highly beneficial which enhanced the maximum yield of the cabbage varieties. Accordingly, at 15 ppm concentration of GA3 + NAA mixture, the highest yield of untrimmed and trimmed heads was 743.83 and 688.50 q ha^{-1}, respectively (Table 2). So much increase in yield due to 15 ppm plant growth substances concentration may be due to similar increases in growth and yield-attributes of cabbage by the applied dose of PGS concentration. The present findings are in accordance with those of Singh *et al.* (2001) and Singh *et al.* (2003).

Economics

The data (Table 2) revealed that Krishna (Hybrid) gave maximum net return (₹. 93893 ha^{-1}) with B:C ratio (4.31) followed by Kranti (Hybrid) giving net return (₹. 89340 ha^{-1}) with B:C ratio of 4.12. The net return was in accordance with the gross

income obtained from cabbage yield of the varieties. Accordingly, the hybrid varieties viz. Krishna and Kranti treated with 15 ppm concentration of GA3 + NAA mixture augmented the net returns. Thus, Krishna (Hybrid) with 15 ppm concentration recorded the maximum net return (₹. 1,05,792 ha^{-1}). The second best interaction Kranti (Hybrid) treated with 15 ppm concentration achieving net return (₹. 1,02,632 ha^{-1}). It may be concluded that Krishna (Hybrid) with GA3 + NAA, 15 ppm concentration recorded maximum growth parameters, yield and net returns.

REFERENCES

Abu-Grab, O.S. and Ebrahim, M.K.H. (2010) Physiological response of field grown onion to some growth regulators. *Egyptian Journal of Horticulture* **27**(1): 117-130.

Anand, Bahadur, Maurya, V.N. and Bahadur, A. (2001) Effects of GA3 and foliar feeding of urea on bulb production of onion (*Allium cepa* L.). *Vegetable Science* **28**(1): 90-92.

Chaudhary, Santosh, Soni, A.K. and Jat, N.K. (2012) Effect of hormones on growth, yield and quality of sprouting broccoli cv. CBH-1. *Indian Journal of Horticulture* **69**(4): 550-554.

Das, R., Thapa, U, Mandol, A.R. and Debnath, S. (2013) Effect of different concentrations of plant growth substances on growth and yield of cauliflower (Brassica oleraceae var. botrytis Linn.). *Environment and Ecology* **31**(1A): 334-337.

Kanaujia, V.P., Sachan, C.P. and Tripathi, S.K. (2002) Effect of growth regulators and stratification on germination and vigour of onion (*Allium cepa* L.). *Seed Research* **30**(1): 155-157.

Khamparia, S.K. (1998) Morpho-physiological variability in relation to plant growth regulators on onion. Ph.D. Thesis submitted to A.P.S. University, Rewa (M.P.).

Patil, V.S. and Patil, A.A. (1997) Effect of NAA and GA on growth and yield of cabbage (*Brassica oleraceae* var. Capitata Linn.) varieties. *Progressive Horticulture* **19**(2): 50-52.

Shaikh, A.M., Vya Karanahal, B.S. and Dharmatti, M.P.R. (2002) Influence of bulb size and growth regulators on growth, seed yield and quality of onion cv. Nasik Red. *Seed Research* **30**(2): 223-229.

Shivram, A.C. and Jat, N.L. (2013) Effect of bioregulators and other time of application on growth and yield of cumin. *Annals of Plant and Soil Research* **15** (1): 5-8.

Singh, D.K., Singh, N.B. and Bhonde, S.R. (2003) Effect of growth regulators on bulb development in onion during kharif season. *Newsletter MHRDFC* **33**(2): 1-4.

Singh, Mahabir and Rajodia, R.B. (2001) Effect of Gibberellic acid on growth and yield attributes of radish varieties. *Crop Research* 21(2): 174-177.

Tomar, R.S. (2013) Effect of GA and starter solution of NPK fertilizer on growth, yield and quality of cabbage variety "Golden acre". M.Sc (Ag) Thesis submitted to RVSKVV, Gwalior (M.P.)

Verma, R. and Maurya, B.R. (2013) Effect of bioregulators and fertilizers on yield and nutrient uptake by cabbage. *Annals of Plant and Soil Resrrearch* **15** (1): 35-38.

Wagh, R.S. and Deore, B.P. (2012) Effect of growth substances on seed yield and quality of onion. *Maharashtra Journal of Agriculture University* **50**(1): 144-146.