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Effect of chemicals on growth and yield of baby corn (*Zea mays* L.)

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Abstract
An investigation was carried out on "Effect of chemicals on growth, yield and quality of baby corn (*Zea mays* L.)" at Horticulture Polytechnic, ACHF, NAU, Navsari, Gujarat, India during Summer 2020. The experiment was laid out in randomized block design (RBD) with eight treatments *viz.*, T_1: GA_3 40 ppm; T_2: NAA 40 ppm; T_3: mepiquat chloride 200 ppm; T_4: cycocel 200 ppm; T_5: paclobutrazol (PBZ) 200 ppm; T_6: putrescine 50 ppm; T_7: PBZ 200 ppm Seed soaking and T_8: Control which, were replicated thrice. All the chemicals were applied as foliar spray at 30 DAS, except T_7 treatment. In this treatment seeds were soaked on previous day in PBZ 200 ppm for three hours and kept in shade. The results revealed that maximum plant height at 45 DAS (147.87 cm), at 60 DAS (239.47 cm) and at last harvest (244.47 cm) was recorded with the application of GA_3 40 ppm. Reflective effect of foliar application of mepiquat chloride 200 ppm was detected in getting higher yield parameters *viz.*, cob weight (42.660 g plant^{-1}) and cob yield (2.593 t ha^{-1}) without husk. Number of cobs (3.53 plant^{-1}) were found maximum with application of GA_3 40 ppm. Application of PBZ 200 ppm seed soaking improved cob yield with husk (15.703 t ha^{-1}) whereas, maximum green fodder yield (43.14 t ha^{-1}) was obtained with the application of NAA 40 ppm. Effect of different chemicals on days required for 50% silking, plant height at 45 DAS, cob length and girth as well as harvest index from dry cobs were found non-significant.

Keywords: Baby corn, GA_3, mepiquat chloride, NAA, paclobutrazol (PBZ), putrescine

Introduction
The baby corn is considered as suitable choice for improving the income of farmers. The sweet succulent and delicious baby corn is a medium plant type and provides green ears within 65 to 75 days after sowing. Baby corn is gaining importance as vegetable and salad in and around world cities. Being short duration in nature it facilitates to take up second crop simultaneously as intercrop and helps the farmer to get more returns per unit area per unit time by increasing cropping intensity (Rani *et al.*, 2015) [17].

Baby corn for vegetable purpose is successfully grown in Asian countries like Thailand, Taiwan, Sri Lanka and Burma. It has been developed into a multi-dollar business because of its potential as a value-added product for export and a good food substitute. In India, cultivation of baby corn is a recent development and its industry is still at a juvenile stage. Its cultivation is only now picking up seriously in Meghalaya, Western Uttar Pradesh, Haryana, Maharashtra, Gujarat, Karnataka and Andhra Pradesh. The lack of knowledge about the use and economic importance of baby corn as well as unavailability of appropriate production technology are the major constraints for its popularization among Indian maize growers. As far as Gujarat is concerned there is an adequate possibilities of increasing baby corn cultivation as an additional *kharif* vegetable crop in the areas having low to medium rainfall and an additional summer vegetable crop in the areas having irrigation facilities. It's low water requirement and short duration are the supplemental benefits to adopt or to increase the cultivation of this crop.

Feeding the increasing population will be a great problem in nearby decades and finding the ways and means to increase the yield of agricultural/horticultural crops beyond its potentiality is a big challenge but PGRs is a useful tool and has proven its capacity of increasing yield of so many horticultural crops. Plant growth regulators are substances that influence physiological processes of plants at very low concentrations. They are organic compounds, called bio stimulants or bio inhibitors, act inside plant cells to stimulate or inhibit specific enzyme's or enzymes systems and help in regulating plant metabolism. Keeping these in mind a field experiment on this aspect was framed.

Materials and Methods

A field experiment on baby corn var. GAYMH 1 was conducted at Horticulture Polytechnic, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India during summer 2020. The experiment was laid out in randomized block design with a set of treatments comprised of GA_3 40 ppm (T_1); NAA 40 ppm (T_2); mepiquat chloride 200 ppm (T_3); CCC 200 ppm (T_4); paclabutrazol (PBZ) 200 ppm (T_5); putrescine 50 ppm (T_6); PBZ 200 ppm Seed soaking (T_7) and Control (T_8) replicated thrice. Seed soaking was done on previous day of sowing for 3 Hrs. and kept in shade. Foliar application was done at 30 DAS. The soil of experimental site was well drain as well as medium water holding capacity and reasonably suitable for baby corn growing. The well decomposed farm yard manure (15 t ha^{-1}) and inorganic fertilizers as per recommended dose (120 kg N, 60 kg P_2O_5 and 0 kg K_2O ha^{-1}) were applied in the form of urea and single super phosphate. The whole quantity of FYM applied to each plot after layout preparation and mixed thoroughly with the soil. Nitrogen (50%) and phosphorus (100%) were applied at the time of sowing. Remaining 50% nitrogen was applied at 30 DAS. The planting was done at the spacing 60 × 25 cm with gross plot size 2.4 × 2.5 m and net plot size 1.2 × 2.0 m.

Statistical analysis was done as per the methods described by Panse and Sukhatme (1985) [15].

Results and Discussion

Growth Parameters

Days to 50% Germination

All spraying treatments were given at 30 DAS, hence the data on days to 50% germination did not show any treatment effect except T_7 treatment, which was the only treatment given to seeds before sowing. The data on days to 50% germination (Table 1), revealed that the seeds treated with PBZ 200 ppm germinated 1.33 days later which might be due to the chemical that adheres to the seed coat of treated seeds and then diffuses into the growth medium where it can be taken up by the roots. Similar results were obtained by Finn and Loyal (1990) [3] in apple and Pasian and Bennett (2001) [16] in marigold, geranium and tomato.

Days to 50% Silking

The effect of different treatments on days to 50% silking was found non-significant but treatment T_6 (putrescine 50 ppm) indicated earliness of 1.66 days than control treatment. The plants which were germinate late in T_7 treatment later on recovered their growth and 50% silking was observed simultaneously with control treatment and both these treatments required 61.33 days for 50% silking. Whereas, treatment T_4 (CCC 200 ppm) required maximum days (61.67) for 50% silking (Table 1).

Plant Height

Results pertaining to the plant height at 45 DAS, 60 DAS and at harvest are given in Table 1. Results reveled that the effect of different treatments on plant height at 45 DAS was found non-significant but at 60 DAS and at harvest it was found significant and recorded maximum plant height of 239.47 cm and 244.47 cm, respectively with the foliar application of GA_3 40 ppm (T_1). Plant height at both stages were statistically remained at par with T_2, T_6 and T_8 treatments.

Increased plasticity of cell wall followed by hydrolysis of starch to sugars which lower the water potential of the cell, resulting in entry of water into the cell causing elongation. These osmotic driven responses under influence of gibberellic acid might have attributed for an increase in photo synthetic activity also which, might accelerate translocation and ultimately increasing efficiency of utilizing photosynthetic products, resulting in increased cell elongation and rapid cell division in growing portion. Similar results were witnessed by Singh *et al.* (2018) [18] in maize, Pandey *et al.* (2004) [14] in garden pea, Nabi *et al.* (2014) [11] in cowpea as well as Ngatia *et al.* (2004) [12] and Fawzy *et al.* (2011) [2] in French bean.

Table 1: Effect of different chemicals on growth parameters of baby corn var. GAYMH 1

Treatments	Days to 50% Germination	Days to 50% Silking	Plant height (cm)		
			45 DAS	60 DAS	At last harvest
T_1: GA_3 40 ppm	7.00	61.33	147.87	239.47	244.47
T_2: NAA 40 ppm	7.00	61.00	145.80	237.80	243.33
T_3: Mepiquat chloride 200 ppm	7.00	60.33	138.47	202.27	202.73
T_4: CCC 200 ppm	7.00	61.67	142.20	204.40	204.93
T_5: PBZ 200 ppm	7.00	61.00	142.80	206.00	207.07
T_6: Putrescine 50 ppm	7.00	59.67	144.67	232.60	237.80
T_7: PBZ 200 ppm (Seed soaking)	8.33	61.33	141.07	207.00	208.67
T_8: Control	7.00	61.33	143.13	228.87	234.87
S.Em. ±	0.12	0.50	3.74	9.25	9.16
C.D. at 5%	0.36	NS	NS	28.05	27.80
C.V. %	2.85	1.43	4.52	7.29	7.12

Yield parameters

Number of cobs plant^{-1}

The data given in Table 2, reveals that the number of cobs plant^{-1} was significantly influenced by different treatments under study and all the treatment produced higher number of cobs plant^{-1} than control (2.93 cobs plant^{-1}). Treatment T_1 (GA_3 40 ppm) produced maximum number of cobs (3.53 plant^{-1}) which was statistically remained at par with all the treatments except T_4 and control.

It might be due to application of growth hormones that affected the strength of physiological sources and improves growth parameters of plants evidently reflected in increased plant height at all three growth stages. The present findings are in conformity with Singh *et al.* (2018) [18] in maize. Results established by Pandey *et al.* (2004) [14] in pea and by Ngatia *et al.* (2004) [12] in French bean are also in confirmatory.

Cob Length

Though the cob length was not affected by different treatments under study, maximum cob length (13.77 cm) was obtained with treatment T_3 (mepiquat chloride 200 ppm) and

that of minimum (12.09 cm) was obtained with T_4 (CCC 200 ppm) treatment (Table 2).

Cob girth

Similarly, the effect of different chemical treatments on girth of cob was also found non-significant (Table 2) but treatment T_3 (mepiquat chloride 200 ppm) obtained maximum girth (4.56 cm) while minimum girth (4.12 cm) was also obtained under T_4 (CCC 200 ppm) treatment.

Cob yield Plant^{-1}

The data on cob yield plant^{-1} given in table 2, showed significant results. All the treatments under study significantly obtained more cob weight plant^{-1} compared to control. Treatment T_3 (mepiquat chloride 200 ppm) recorded maximum cob yield (42.660 g plant^{-1}) butit was statistically remained at par with T_7, T_1 and T_2 treatments. This might be the results of an inhibition of vegetative growth and thus making availability of food reserves for developing fruits. The present study also corroborated with the findings of Gutam *et al*. (2009) [5] in bell pepper and Laddha *et al*. (2018) [7] in brinjal.

Cob yield Ha^{-1} (t)

The data pertaining to cob yield ha^{-1} with and without husk as influenced by application of different chemicals are presented in Table 2. Among all the treatments, treatment T_7 (PBZ 200 ppm seed soaking) recorded highest cob yield (15.703 t ha^{-1}) with husk which was statistically remained at par with T_3, T_2, T_5 and T_1 treatments. Treatment T_4 recorded lowest cob yield (12.433 t ha^{-1}) with husk.

Crop growth and yield are closely related to the spread of roots, which determines the uptake and utilization of water and nutrients and greater root biomass is significantly and positively correlated with enhanced biomass and yield. Kamran *et al*. (2018) [6] reported positive effect on root growth with seed soaking in paclobutrazol which leads to improved ear characteristics and grain yield of maize. However, treatment of seed soaking in paclobutrazol recorded lesser cob yield (without husk) than treatment of mepiquat chloride because of lesser fruit weight, fruit length and fruit girth which might be associated with inhibition of gibberellin biosynthesis. The present findings thus agreed with Magnitskiy *et al*. (2006) [9] in cucumber.

Among all the treatments, T_3 (mepiquat chloride 200 ppm) treatment recorded maximum cob yield of 2.593 t ha^{-1} without husk and it is statistically remained at par with T_7, T_2, T_1 and T_6 treatments. Treatment T_8 recorded lowest cob yield (1.927 t ha^{-1}) without husk.

Increase in yield parameters due to mepiquat chloride spray might be due to the effectiveness of chemical to translocate photosynthates from source to sink and shortening of distance between source and sink too. Mepiquat chloride as a growth retardant would have arrested the excessive growth and thus minimized transpiration losses and increased the chlorophyll content of the plants to supply photosynthates for its larger sink and thereby increased the yield attributes of the treated plants. The positive effect of mepiquat chloride on yield was also observed by Muthukumar *et al*. (2005) [10] and Golada *et al*. (2018) [4] in baby corn and Chandrashekhara *et al*. (2018) [1] in maize. Results established by Gutam *et al*. (2009) [5] in bell pepper and Pal *et al*. (2017) [13] in onion are also in confirmatory.

Green fodder yield (t ha^{-1})

Green fodder yield (Table 2) showed significant difference with respect to application of different chemicals. Treatment T_2 (NAA 40 ppm) recorded maximum green fodder yield (43.14 t ha^{-1}) which was statistically remained at par with all the treatments except control which recorded the lowest green fodder yield (36.21 t ha^{-1}).

According to Muthukumar *et al*. (2005) [10], increase in fodder yield due to NAA spray might be the result of increased cell division, cell enlargement and elongation which ultimately resulted in increased plant height, leaf area index and total biomass. Similar findings were reported by Muthukumar *et al*. (2005) [10] in baby corn and Lakshmamma and Rao (1996) [8] in black gram.

Harvest Index (%)

A perusal of the data from table 2, reveals that the harvest index was found non-significant. However, application of mepiquat chloride (200 ppm) at 30 DAS resulted in highest harvest index (6.43%) which might be the result of reduced plant height, reduced distance between source and sink and lower the dry matter production which ultimately leads to lesser green fodder yield and higher cob yield. Muthukumar *et al*. (2005) [10] and Golada *et al*. (2018) [4] also noted reduced green fodder yield and increased cob yield in baby corn and thus support these findings.

Table 2: Effect of different chemicals on yield parameters of baby corn var. GAYMH 1

Treatments	Number of cobs plant^{-1}	Cob length (cm)	Cob girth (cm)	Cob yield plant^{-1} (g)	Cob yield ha^{-1} (t)		Green fodder yield (ha t^{-1})	Harvest index (%)
					With husk	Without husk		
T_1: GA_3 40 ppm	3.53	13.31	4.51	39.491	14.573	2.337	41.60	5.30
T_2: NAA 40 ppm	3.47	13.53	4.54	39.380	15.010	2.377	43.14	5.22
T_3: Mepiquat chloride 200 ppm	3.47	13.77	4.56	42.660	15.340	2.593	37.78	6.43
T_4: CCC 200 ppm	3.13	12.09	4.12	37.115	12.433	2.107	32.63	6.15
T_5: PBZ 200 ppm	3.33	13.17	4.22	38.062	14.847	2.240	39.97	5.37
T_6: Putrescine 50 ppm	3.33	13.39	4.32	37.637	13.353	2.260	40.19	5.32
T_7: PBZ 200 ppm (Seed soaking)	3.40	13.25	4.31	39.989	15.703	2.407	40.21	5.65
T_8: Control	2.93	12.96	4.23	29.499	13.683	1.927	36.21	5.06
S.Em. ±	0.10	0.60	0.16	1.384	0.589	0.112	1.92	0.34
C.D. at 5%	0.32	NS	NS	4.198	1.785	0.340	5.83	NS
C.V. %	5.43	7.82	6.29	6.31	7.10	8.49	8.54	10.63

Conclusions

On the basis of results obtained from the present investigation, it can be concluded that the application of NAA 40 ppm (T_2) enhanced growth and yield parameters along with the quality of baby corn. Moreover, that this treatment also recorded the highest BCR with highest net income and found economically best for cultivation of baby corn.

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