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Growth and Yield of Baby Corn (*Zea mays* L.) as Influenced by Plant Growth Regulators and Different Time of Nitrogen Application

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Abstract: Field experiment was carried out at Eastern Block farm, Tamil Nadu Agricultural University, Coimbatore during late *rabi* (February-March) 2003 season to find out the effect of different plant growth regulators and split application of nitrogen on the productivity of baby corn. The field trial was laid out in split plot design and replicated thrice. Growth regulators *viz.*, Mepiquat chloride @ 200 ppm, NAA @ 40 ppm, Putrescine @ 50 ppm along with water spray (control) were taken in main plots and split application of nitrogen *viz.*, ½ basal + ½ N at 25 DAS, ½ basal + ½ at 45 DAS, ½ basal + ¼ at 25 DAS + ¼ at 45 DAS; and ¼ basal + ½ at 25 DAS + ¼ at 45 DAS were taken in sub plots. The results revealed that growth regulators application had significant influence on growth parameters of baby corn. Higher values of growth parameters were registered with NAA @ 40 ppm. Application of N in split doses had marked influence on the above parameters and the values were highest with application as ½ basal + ¼ at 25 DAS + ¼ at 45 DAS. Cob yield was higher under Mepiquat chloride @ 200 ppm spray (8003 kg ha^{-1}) which was comparable with NAA @ 40 ppm spray (7872 kg ha^{-1}). With regard to split application of nitrogen, application of nitrogen as ½ basal + ¼ at 25 DAS + ¼ at 45 DAS produced significantly higher cob yield (8122 kg ha^{-1}) when compared to other treatments.

Key words: Baby corn, growth regulators, time of N application, cob yield

INTRODUCTION

Maize (*Zea mays* L) is the third most important cereal crop next to rice and wheat and has the highest production potential among the cereals. For diversification and value addition of maize as well as growth of food processing industries, an interesting recent development is of growing maize for vegetable purpose, which is known as 'baby corn'. It is a small young corn ear harvested at the stage of silk emergence. Baby corn ears in light yellow colour with regular row arrangement, 10-12 cm long and a diameter of 1.0 -1.5 cm are preferred in the market. De-husked young ear is used as salad, vegetable, soup, pickles, etc.,[15]. Baby corn production, being a recent development has proved an enormously successful venture in countries like Thailand and Taiwan. Attention is now being paid to explore its potential in India, for earning foreign exchange besides higher economic returns to the farmers. Thus, it is essential to standardize the agro techniques for baby corn growing in order to popularize its cultivation among farming community. Timing of nitrogen application based on the requirement is important to increase the N use efficiency and growth regulators improve the effective partitioning and translocation of accumulates from source to sink in the field crops[13]. Therefore, an attempt was made to study the response of baby corn to different plant growth regulators and split application of nitrogen under irrigated conditions.

MATERIALS AND METHODS

Field experiment was conducted in Eastern Block farm, Tamil Nadu Agricultural University, Coimbatore. The experimental site is located at a latitude of 11°N, longitude of 77°E and an altitude of 426.7 m above mean sea level. Nutrient status of the experimental field is low in available N (228.5 $kgha^{-1}$), medium in available P (13.2 kg ha^{-1}) and high in available K (381.6 $kgha^{-1}$). Texture of the experimental area was sandy clay loam (*Typic Ustropept*). Baby corn composite COBC1 was used as test crop. The experiment was laid out in split plot design and the treatments were replicated thrice. The growth regulator treatments were taken in main plots and N split application treatments were laid out in sub plots (Table 1).

Farm Yard Manure was applied basally @ 12.5 t ha^{-1} and spread equally over entire experimental field. Inorganic fertilizers used were urea (46 % N), single super

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Table: 1: Effect of plant growth regulators and split application of nitrogen on growth attributes and yield of baby corn.

Treatments	Plant height (cm)			LAI			DMP (Kg ha^{-1})		
	25 DAS	45 DAS	Harvest	25 DAS	45 DAS	Harvest	25 DAS	45 DAS	Harvest
Growth regulators									
T_1- Control (water spray)	40.76	121.93	174.73	0.76	3.68	3.32	677	7323	7668
T_2 – Mepiquot chloride (200 ppm)	40.89	115.72	165.38	0.76	3.39	3.15	674	7099	7312
T_3 – NAA (40 ppm)	40.40	137.04	190.50	0.77	4.14	3.69	662	7861	8193
T_4 – Putrescine (50 ppm)	39.93	128.21	182.74	0.76	3.83	3.49	669	7618	7909
SEd	0.84	1.91	2.91	0.01	0.07	0.05	6.1	73	80
CD (P=0.05)	NS	4.66	7.12	NS	0.17	0.12	NS	179	197
Time of N application									
N_1 – ½ basal + ½ at 25 DAS (control)	40.89	130.70	175.10	0.77	3.94	3.38	678	7681	7706
N_2 - ½ basal + ½ at 45 DAS	41.13	120.10	166.58	0.77	3.61	3.11	681	7253	7434
N_3 – ½ basal + ¼ at 25 DAS + ¼ at 45 DAS	41.33	129.07	189.78	0.78	3.89	3.74	674	7605	8189
N_4 – ¼ basal + ½ at 25 DAS + ¼ at 45 DAS	38.63	123.02	179.88	0.73	3.71	3.42	649	7362	7793
SEd	0.93	2.87	3.95	0.01	0.10	0.09	10.9	102	120
CD (P=0.05)	1.92	5.92	8.14	0.03	0.20	0.19	22.6	211	248

Interaction: Absent

phosphate (16 % P_2O_5) and muriate of potash (60 % K_2O) for supplying nitrogen, phosphorus and potassium nutrients respectively. Inorganic fertilizers were applied to each plot as per treatment schedule. All the agronomic practices were carried out uniformly to raise the crop[3]. Five plants were selected randomly from each net plot and tagged. At 25, 45 DAS and at harvest, all biometric observations were recorded from the tagged plants. Plant height was recorded from base of the plant to tip of the terminal leaf on main stem and expressed in cm. Then leaf area index was calculated using the following formula[1].

Five plants from sampling rows of each plot were uprooted for recording dry matter production, washed with water and roots were separated. The plant parts were dried under shade for few days, oven dried at 75°C till a constant weight was obtained and expressed in kg ha^{-1}. Immediately after emergence of the silk, cobs were harvested along with sheath from each net plot. Totally six harvestings were done at an interval of two days. Length, diameter and weight of the cob from the representative plants were measured from which mean values were attained. Cob sheath of tagged plants in each plot was peeled-off and the length, diameter and weight of corn inside the sheath were measured. Number of cobs from the tagged plants was counted and from that mean number of cobs (Lakh ha^{-1}) was calculated. Ratio between the weight of cob and corn (cob-corn ratio) was worked out from the harvested cobs. Period from start of first harvest to the last harvest was recorded and expressed in days (Harvesting period). The cobs from net area of each plot were harvested separately, weighed and recorded as young cob yield (kg ha^{-1}). Data were subjected to statistical analysis[5].

RESULTS AND DISCUSSIONS

Growth parameters: Growth regulator application had significant influence on plant height, leaf area index (LAI) and dry matter production (DMP) of baby corn at all growth stages (Table 1). Baby corn sprayed with NAA @ 40 ppm produced higher values of growth parameters whereas Mepiquat chloride @ 200 ppm significantly reduced all growth parameters over other treatments. Enhancement in growth parameters with NAA application might be due to cell wall extensibility and cell wall loosening[12] and increased cell division and elongation in the presence of endogenous GA[7]. NAA could increase the growth parameters of treated plants[6]. Mepiquat chloride, being an anti-gibberellin usually causes reduction in cell elongation. Reduction in growth parameters due to foliar application of Mepiquat chloride might be attributed to the inhibition of synthesis of Gibberellin which has role in cell division and cell elongation. Similar findings of reduction in growth parameters due to Mepiquat chloride were also reported earlier[12,14]. The negative effect of Mepiquat

Table 2: Influence of plant growth regulators and split application of nitrogen on yield parameters of baby corn.

Treatments	Length of cob (cm)		Diameter of cob (cm)		Weight of cob (g)		Length of corn (cm)		Diameter of corn (cm)		Weight of corn (g)	
	First harvest	Fifth harvest	First harvest	Fifth harvest	First harvest	Fifth harvest	First harvest	Fifth harvest	First harvest	Fifth harvest	First harvest	Fifth harvest
Growth regulators												
T_1- Control (water spray)	22.25	19.08	3.27	2.81	46.33	39.50	9.33	8.10	1.41	1.33	8.43	7.78
T_2 – Mepiquot chloride (200 ppm)	26.83	24.72	3.72	3.20	52.88	45.50	10.85	9.24	1.71	1.63	10.15	8.63
T_3 – NAA (40 ppm)	26.26	24.01	3.66	3.18	51.45	44.93	10.73	9.06	1.68	1.60	9.91	8.58
T_4 – Putrescine (50 ppm)	24.20	22.05	3.48	2.98	48.95	42.18	9.92	8.41	1.56	1.42	9.22	8.21
SEd	0.31	0.54	0.04	0.03	0.86	0.94	0.14	0.11	0.03	0.02	0.16	0.09
CD (P=0.05)	0.75	1.32	0.10	0.08	2.11	2.31	0.34	0.28	0.06	0.05	0.38	0.23
Time of N application												
N_1 – ½ basal + ½ at 25 DAS (control)	25.35	22.10	3.51	2.99	49.57	42.38	10.21	8.55	1.57	1.48	9.37	8.39
N_2 - ½ basal + ½ at 45 DAS	22.53	20.25	3.21	2.78	45.93	38.13	9.11	8.07	1.44	1.31	8.35	7.53
N_3 – ½ basal+¼ at 25 DAS+¼ at 45 DAS	27.85	24.98	3.86	3.31	53.83	47.88	11.13	9.48	1.74	1.65	10.31	8.88
N_4 – ¼ basal+½ at 25 DAS+¼ at 45 DAS	25.60	22.58	3.55	3.08	50.05	43.33	10.36	8.70	1.62	1.54	9.65	8.49
SEd	0.55	0.83	0.09	0.06	1.20	1.42	0.22	0.17	0.03	0.03	0.24	0.16
CD (P=0.05)	1.14	1.71	0.18	0.12	2.47	2.93	0.46	0.34	0.07	0.07	0.49	0.32

Interaction: Absent

chloride on growth parameters was due to reduced cell division and cell enlargement which in turn reduced the growth attributes was also observed earlier[16].

There was a significant response on growth parameters due to split application of nitrogen at different stages. At harvest, the highest growth parameters were recorded by N_3 and the lowest values were recorded with N_2. Highest growth parameters recorded under N_3 might be ascribed to the fact that enhanced availability of N_3, which is required for vegetative growth, throughout the crop period. Split application of nitrogen according to the growth phases enhanced its better utilization by the crop by reducing the N losses and matching the supply with crop demand. Increase in growth parameters resulted on account of cumulative effect of need based, gradual and continuous supply of N at the time of its critical requirement by the crop, efficient utilization of supplied N and lesser N loss[4].

The interaction effect was not significant among the treatments.

Yield parameters: Growth regulators spray had positive influence on yield parameters of baby corn. Crop sprayed with Mepiquat chloride @ 200 ppm produced the highest values of yield parameters *viz*., length, diameter and weight of cob and corn (Table 2). However, this was comparable with application of NAA @ 40 ppm. Putrescine 50 ppm spray was significantly superior over control for all the yield parameters. Increase in yield parameters due to Mepiquat chloride spray might be due to effective translocation of photosynthates from source to sink which is resulted from shortening of distance between source and sink. 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. NAA, being an auxin, promoted vegetative growth by active cell division, cell enlargement and cell elongation and thus helped in improving growth characteristics and also in stimulating reproductive growth[10].

Synergistic effect was observed on yield parameters of baby corn due to split application of nitrogen treatments. Among N treatments, N_3 had produced maximum values of yield attributes and the lowest values were recorded with N_2. Increase in yield attributes with N_3 might be due to the fact that application of nitrogen in three splits must have helped in continuous and gradual supply of nitrogen to the plants to maintain greenness of leaves for longer period which in turn helped in greater dry matter accumulation which might have contributed

Table 3: Yield parameters and yield (green cob and green fodder) of baby corn as effected by plant growth regulators and split application of nitrogen.

Treatments	Cob-corn ratio		Harvesting period (days)	Number of cobs (Lakh ha^{-1})	Green cob yield (kg ha^{-1})	Green fodder yield (t ha^{-1})
	First harvest	Fifth harvest				
Growth regulators						
T_1- Control (water spray)	5.32	5.18	15.0	1.96	7291	30.25
T_2 – Mepiquot chloride (200 ppm)	5.20	5.11	15.0	1.96	8003	28.05
T_3 – NAA (40 ppm)	5.22	5.13	15.0	2.13	7872	32.14
T_4 – Putrescine (50 ppm)	5.31	5.15	15.0	1.96	7569	31.26
SEd	0.07	0.07	0.2	0.10	112	0.53
CD (P=0.05)	NS	NS	NS	NS	231	1.29
Time of N application						
N_1 – ½ basal + ½ at 25 DAS (control)	5.22	5.15	15.0	2.13	7642	30.97
N_2 - ½ basal + ½ at 45 DAS	5.26	5.17	15.0	1.96	7269	26.44
N_3 – ½ basal + ¼ at 25 DAS + ¼ at 45 DAS	5.13	5.11	15.0	1.96	8122	33.14
N_4 – ¼ basal + ½ at 25 DAS + ¼ at 45 DAS	5.14	5.13	15.0	1.96	7701	31.23
SEd	0.09	0.08	0.2	0.12	155	0.70
CD (P=0.05)	NS	NS	NS	NS	320	1.45

Interaction: Absent

much to developing sink and thereby improved the yield attributes[8].

However, there was no significant difference between the treatments on cob-corn ratio, harvesting period and number of cobs (Lakh ha^{-1}) (Table 3).

The interaction effect between the treatments was not significant.

Green cob yield: Growth regulators spray had positive influence on green cob yield of baby corn (Table 3). The crop sprayed with Mepiquat chloride @ 200 ppm produced the highest cob yield (8003 kg ha^{-1}) and this was comparable with application of NAA @ 40 ppm (7872 kg ha^{-1}). Putrescine 50 ppm spray was significantly superior (7569 kg ha^{-1}) over control (7291 kg ha^{-1}). The increase in yield due to Mepiquat chloride spray might be due to increased yield attributes which in turn resulted from effective translocation of photosynthates from source to sink due to the shortening of distance between source and sink.

Cob yield increased due to increased mobilization of reserve food materials to developing sink through increase in hydrolyzing and oxidizing enzyme activities[16]. NAA, being an auxin, promoted vegetative growth by active cell division, cell enlargement and cell elongation and thus helped in improving growth characteristics and also in stimulating reproductive growth[10].

Split application of nitrogen treatments had significant influence on the green cob yield of baby corn. Among the N treatments, N_3 had produced maximum cob yield of 8122 kg ha^{-1}. Application of nitrogen in three splits must have helped in continuous and gradual supply of nitrogen to the plants to maintain greenness of leaves for longer period which in turn helped in greater dry matter accumulation and contributed much to the developing sink and thereby increased the green cob yield[8]. Application of N in three split doses is conducive for regulating the supply of fertilizer N than almost whole of the active growth phase of the plant[11]. Increase in yield under N_3 may also be due to the fact that when a considerable amount of N is applied at or near to anthesis, there is a greater possibility of its accumulation in sink rather than in other vegetative parts[9].

Green fodder yield: Application of growth regulators exhibited significant influence on green fodder yield of baby corn. NAA @ 40 ppm (T_3) produced significantly higher (32.14 t ha^{-1}) fodder yield but statistically comparable with Putrescine @ 50 ppm (T_4). Application of Mepiquat chloride @ 200 ppm (T_2) produced lowest green fodder yield (28.05 t ha^{-1}). Since Mepiquat chloride is a growth retardant, resulted in reduced plant height and drymatter production and finally reduction in fodder yield. Similar results of reduction in fodder yield due to Mepiquat chloride application were also reported[2,14]. NAA application significantly enhanced the fodder yield over other treatments. Increase in fodder yield due to NAA spray might be due to increase in plant height, leaf area index and total biomass which might be due to increased cell division, cell enlargement and elongation. Similar findings were also reported in black gram[7] and in coriander[10].

Discernible variation was observed due to split application of nitrogen on fodder yield of baby corn.

Application of N in three splits i.e. ½ basal +¼ at 25 DAS + ¼ at 45 DAS (N_3), produced the maximum fodder yield of 33.14 t ha^{-1}. The treatments N_4 (¼ basal +½ at 25 DAS + ¼ at 45 DAS) and N_1 (½ basal + ½ at 25 DAS) were significantly superior over N_2 (½ basal + ½ at 45 DAS). Discussion made under green cob yield also holds good here also.

The interaction effect was not significant among the treatments.

Conclusion: Application of Mepiquat chloride @ 200 ppm or NAA @ 40 ppm spray and split application of nitrogen as ½ basal + ¼ at 25 DAS + ¼ at 45 DAS produced significantly higher growth and yield of baby corn when compared to the rest of combinations.

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