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Influence of Herbicides as Growth Regulators on Growth and Yield of Baby Corn (*Zea mays* L.)

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Abstract: Field experiments were conducted on sandy clay loam soils during late Rabi (January-March) and Kharif (June-September) seasons of 2002 to study the effect of herbicides at low concentrations as growth regulators on productivity of baby corn. The experiment was laid out in randomized complete block design with three herbicides each at two different concentrations (2,4-D @ 25 and 50 ppm, atrazine @ 50 and 100 ppm and glyphosate @ 5 and 10 ppm) along with control (water spray) and absolute control (no spray). The results were indicative that low herbicide concentrations promoted the growth and yield attributes in baby corn. Application of 2,4-D @ 50 ppm significantly increased growth parameters (plant height, number of green leaves plant^{-1}, LAI and DMP) and yield attributes viz., length of cob and corn, weight of cob and corn, whereas significantly reduced cob-corn ratio, in comparison with 2,4-D @ 25 ppm and both concentrations of either atrazine or glyposate. Phenological stages such as days to tassel emergence and cob initiation and yield attributes viz., width of cob and corn, number of cobs plant^{-1}, No. of cobs ha^{-1} were not significantly influenced by the herbicides. Increased growth parameters (LAI and DMP), yield attributes (length of cob and corn, weight of cob and corn) due to 2,4-D @ 50 ppm led to higher green cob yield (14.2% over control) and green fodder yield of baby corn over control.

Key words: 2,4-D, atrazine , baby corn, foliar spray, glyposate, herbicide

INTRODUCTION

Maize occupies third position in production among the cereals in the world. Baby corn is the tender ear of the corn harvested from a crop of 60-70 days duration when the silk (1-3 cm) has just emerged and no fertilization has taken place. The young ear, de-husked and de-silked is used as vegetable. Its production is gaining momentum due to its export potential and food value. Genetic potential of this crop has to be tapped to get higher net returns of farmers.

Herbicides at low concentrations are used as growth regulators. 2,4-D belongs to the group of phenoxy herbicides, its activity at low concentration is similar to the Indole Acetic Acid (IAA). The stimulatory effect of 2,4-D was proven in wheat, beans, potato, sugarcane and soybean (Reddy and Reddi, 1999). Triazines have favourable effect on crop plants at sub lethal doses. Atrazine increased total nitrogen, protein content and yield of sweet corn (Reddy and Reddi, 1999) and physiological process in sorghum (Sairam *et al.*, 1988). Glyposate was tried newly. However, there were no reports on foliar spray of these herbicides on baby corn production. Thus, the experiment was conducted to study the effect of 2,4-D and atrazine along with glyphosate at two concentrations on growth and yield of baby corn.

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MATERIALS AND METHODS

The field experiments were conducted in Eastern Block farm of Tamil Nadu Agricultural University, Coimbatore during late Rabi (January-March) and Kharif (June-September) seasons of 2002. Experimental field is located at 11°N latitude, 77°E longitude at an elevation 427 m above MSL and has a semi arid tropical climate with hot dry summers. The mean annual precipitation is 674.2 mm, which occurs mostly during October-December. The soil of the experimental area was sandy clay loam (*Typic Ustropept*) with alkaline pH; low in organic carbon (0.32 and 0.31%) and available N (210.2 and 232.3 kg ha^{-1}), medium in available P (11.2 and 10.6 kg ha^{-1}) and high in available K (436.4 and 412.7 kg ha^{-1}) during late rabi and Kharif 2002 seasons, respectively. Baby corn variety COBC 1 with field duration of 65-70 days was used in the trial.

The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The experiment consisted of nine treatments (Table 1) with three herbicides (atrazine, 2,4-D and glyposate) each with two varied concentrations along with water spray (control) and no spray (absolute control). The seeds were pre-treated with fungicide (Thiram @ 4 g kg^{-1} seeds) and bio-fertilizer (*Azospirillum* @ 600 g ha^{-1} seeds) and sown at a spacing of 45×25 cm. The recommended fertilizers (150:60:40 kg NPK ha^{-1}) were applied in the form of urea (N), single super phosphate (P) and muriate of potash (K). Full dose of phosphorus and half of nitrogen and potassium were applied at the time of sowing. Remaining 50% of nitrogen and potassium were applied at 25 Days After Sowing (DAS) as top dressing. Herbicides 2,4-D @ 25 and 50 ppm, atrazine @ 50 and 100 ppm and glyphosate @ 5 and 10 ppm were prepared by diluting with distilled water and sprayed in evening hours by hand operated sprayer at 25 and 45 DAS. Two-hand weedings (20 and 40 DAS) were done to check the weeds. Need based plant protection measures were carried out timely. Detaselling was done before the emergence of tassel from the flag leaf. The cobs were harvested after 2-3 cm length of silk emergence.

For recording various biometric observations on baby corn, from each net plot a sample consisting of five plants were selected at random and tagged. From the tagged plants, observations on plant height, number of green leaves $plant^{-1}$, Leaf Area Index (LAI) and Dry Matter Production (DMP) at harvest have been recorded. Plant height was measured from ground level to the tip of flag leaf. Number of green leaves $plant^{-1}$ was recorded by counting the number of fully opened green leaves borne on main stem of a plant. Dried and yellow leaves are not considered for counting. The collected leaves from the sample plants were taken to the laboratory and the leaf area was measured by using leaf area meter (LICOR Model 3100). From the leaf area, LAI was calculated.

$$LAI = \frac{\text{Leaf area plant}^{-1}}{\text{Ground area occupied plant}^{-1}}$$

DMP was obtained by drying the plant sample at 70°C till the constant weight was attained. Days taken to the tassel and cob emergence was noted. The yield parameters viz., number of cobs $plant^{-1}$, length, width and weight of green cob, length, width and weight of corn were measured from the sampling plants. Green cob to corn ratio was calculated by dividing the weight of green cobs with weight of corn. Number of cobs (lakh ha^{-1}) was obtained by multiplying the number of plants ha^{-1} and number of cobs $plant^{-1}$. Green cob yield from net plot was harvested alternate days, weighed and expressed in kg ha^{-1}. The data were subjected to statistical analysis (Gomez and Gomez, 1984). Green cob and fodder yields were pooled and analyzed.

RESULTS AND DISCUSSION

Growth Characters

Effect of herbicides at low concentrations on growth of baby corn was significant (Table 1). Plant height, No. of green leaves, LAI and DMP were not varied at 45 DAS (data not shown) whereas at harvest there was significant difference among the treatments during both the seasons. Foliar spray

Table 1: Influence of herbicides as growth regulators on growth parameters of baby corn (pooled mean of two seasons)

Treatments	Plant height (cm)	No. of green leaves plant^{-1}	LAI	DMP (kg ha^{-1})	Days to first tasseling	Days to first cob initiation
2,4-D @ 25 ppm	176.8	9.2	2.96	7848	52.3	56.6
2,4-D @ 50 ppm	188.0	10.4	3.26	8368	52.3	57.0
Atrazine @ 50 ppm	173.3	9.1	2.89	7644	53.0	56.3
Atrazine @ 100 ppm	174.4	9.0	2.89	7716	52.3	56.0
Glyposate @ 5 ppm	175.8	9.2	2.91	7768	52.3	57.0
Glyposate @ 10 ppm	174.8	9.1	2.93	7801	52.0	57.0
Control	173.8	9.0	2.83	7610	52.3	56.3
Absolute control	172.6	9.0	2.81	7534	53.0	56.6
SEd	4.7	0.41	0.13	217	2.3	2.4
CD at 5%	9.9	0.87	0.27	459	NS	NS

of 2,4-D @ 50 ppm produced taller plants (188.0 cm), retained more No. of green leaves plant^{-1} (10.4), maximum LAI (3.26) and more DMP (8368 kg ha^{-1}) at harvest than rest of the treatments. There was no significant difference among atrazine, glyposate 2,4-D @ 25 ppm and control and absolute control. Herbicides show stimulatory effects on some crops at sub lethal doses (Reddy and Reddi, 1999). Phenoxy herbicides have similar action of IAA, which were active at the meristematic tissues causing increased metabolic activities and consequently higher yield in crops (Reddy and Reddi, 1999). Higher growth characters in the 2,4-D @ 50 ppm treatment might be due to higher chlorophyll content, photosynthetic rate, stomatal conductance and nitrate reductase activity at the different growth stages of the crop over other treatments and control. These results are in line with Panwar and Elanchezhian (1998). Elanchezhian and Panwar (1997) also reported that 2,4-D induced the root structure and enhanced the nitrogenous activity in wheat. This might have influenced the chlorophyll content and in turn increased the retention of more leaves, increased LAI and DMP in baby corn.

Phenological stages such as days to tassel emergence and cob initiation were not influenced by the herbicides at these low concentrations.

Yield Attributes

Herbicides spray at 25 and 45 DAS markedly influenced the yield components (length of cob and corn, weight of cob and corn, cob-corn ratio) of baby corn during both the seasons (Table 2). Foliar spray of 2,4-D @ 50 ppm produced longer and heavier cobs (24.5 cm and 47.6 g) and corns (10.7 cm and 11.3 g, respectively), and also reduced the cob-corn ratio (4.2) as compared to 2,4-D @ 25 ppm and also other herbicides (atrazine and glyposate) sprays. Number of cobs plant^{-1}, number of cobs (lakh ha^{-1}), width of cob and corn were also not influenced significantly by the foliar spray of sub lethal dose of herbicides. The possible reason for higher yield attributes with 2,4 D @ 50 ppm application was the higher number of green leaves, LAI and DMP up to harvest, which would have influenced the photosynthetic activity and in turn increased the yield attributes of baby corn. Length of cob and corn had increased with 2,4-D @ 50 ppm which increased the weight of cob and corn. Economic part (corn) was increased due to the 2,4-D @ 50 ppm by reduced cob-corn ratio. Increased yield attributes might be due to the higher growth parameter like more number of green leaves, LAI and DMP. Similar findings have been reported in wheat (Panwar and Elanchezhian, 1998; Nehra and Hooda, 1998), sorghum (Sairam *et al*., 1988) and oats (Sairam *et al*., 1986). Elanchezhian and Panwar (1997) opined that 2,4-D foliar spray increased the amylase activity, root number and shoot dry weight, which in turn increased the yield attributes of wheat.

Yield

There was a sign that foliar spray of herbicides at low concentrations influenced the green cob and green fodder yield of baby corn (Table 2). Foliar spray of 2,4-D @ 50 ppm registered the highest green cob yield (7108 kg ha^{-1}) and the increase was 14.2% over control. Similarly, application of 2,4 D @

Table 2: Influence of herbicides as growth regulators on yield attributes and yield of baby corn (pooled of two seasons)

Treatments	No. of cobs/plant	Length of cob (cm)	Width of cob (cm)	Weight of cob (g)	Length of corn (cm)	Width of corn (cm)
2,4-D @ 25 ppm	2.4	22.1	3.43	44.5	9.60	1.65
2,4-D @ 50 ppm	2.6	24.5	3.51	47.6	10.7	1.72
Atrazine @ 50 ppm	2.4	22.0	3.40	43.8	9.40	1.62
Atrazine @ 100 ppm	2.4	21.7	3.43	43.7	9.50	1.64
Glyposate @ 5 ppm	2.4	21.3	3.40	43.0	9.30	1.60
Glyposate @ 10 ppm	2.4	21.8	3.38	42.9	9.00	1.61
Control	2.6	21.0	3.35	42.0	8.90	1.59
Absolute control	2.4	20.8	3.31	41.9	8.90	1.57
SEd	0.14	0.98	0.15	1.30	0.42	0.08
CD at 5%	NS	2.07	NS	2.71	0.89	NS

Table 2: Continued

Treatments	Weight of corn (cm)	Cob-corn ratio	Baby corn (lakh ha^{-1})	Baby corn yield (kg ha^{-1})	Fodder yield (t ha^{-1})
2,4-D @ 25 ppm	9.6	4.6	2.13	6531	26.7
2,4-D @ 50 ppm	11.3	4.2	2.31	7108	29.9
Atrazine @ 50 ppm	9.5	4.6	2.13	6386	26.4
Atrazine @ 100 ppm	9.5	4.6	2.13	6400	26.2
Glyposate @ 5 ppm	9.4	4.6	2.13	6425	26.4
Glyposate @ 10 ppm	9.4	4.6	2.13	6515	25.9
Control	9.3	4.5	2.31	6222	25.5
Absolute control	9.3	4.5	2.13	6182	25.2
SEd	0.15	0.11	0.10	252	1.2
CD at 5%	0.31	0.23	NS	527	2.5

50 ppm pronounced green fodder yield in both seasons. Whereas, low concentration of 2,4-D (25 ppm) and also sub lethal doses of atrazine and glyposate failed to increase the green cob and green fodder yields of baby corn. It might be due to increased growth and yield parameters, which in turn increased the green cob yield. Higher growth parameters such as plant height, LAI and DMP and also retention of more green leaves contributed to higher green fodder yield. Panwar and Elancheznian (1998) reported that 2,4-D application increased NRase activity, chlorophyll content, which increased the yield attributes and ultimately increased wheat yield. Higher grain yield due to 2,4-D was also reported in wheat (Elanchezhian and Panwar, 1997; Nehra and Hooda, 1998; Singh and Sharma, 1984). Increased nitrogenase and NRase activities and mineral uptake was also reported in several crops (Kennedy and Tehan, 1992; Ridge *et al*., 1992; Panwar, 1993). Increased yield in oats (Sairam *et al*., 1986) and sorghum (Sairam *et al*., 1988) was also reported.

The present study suggests that spraying of 2,4-D @ 50 ppm at 25 and 45 DAS positively enhanced the growth and yield attributes, green cob and green fodder yields of baby corn. If the impact will be proven from further research, this practice will increase the productivity of baby corn and consequently the farmers' income. Undoubtedly, since just one variety was used, results of present study have limited value and further similar study is needed to confirm their validity.

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