Effect of Row-spacing and Weed Management Practices on Growth and Yield of Sweet Corn (Zea mays L. saccharata)

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**Abstract**

The experiment was conducted during the Rabi season 2019 at Prayagraj to study the Effect of row-spacing and weed management practices on growth and yield of Sweet corn (Zea mays L. saccharata). The experiment comprised of 2 factors and 10 treatments viz. Row spacings (40 cm and 50 cm) and weed management practices (Weedy check, Weed free check, Atrazine a.i @ 1.0 kg/ha PRE fb Hand weeding at 20 DAS, Tembotrione a.i @ 120 g/ha PoE and Atrazine a.i @ 1.0 kg/ha PRE fb Tembotrione a.i @ 120 g/ha PoE. Results revealed that application of 50 cm + Weed free check gave maximum plant height (158.6 cm), no. of leaves per plant (12.7), no. of cobs/plant (1.28), no. of grains/cob (819.67). Whereas the maximum dry weight of plant (212.55 g/plant), green cob yield (10.51 t/ha) were obtained with the application of 40 cm + Weed free check. Stover yield (21.33 t/ha) was maximum with the application of 40 cm + Atrazine a.i. @ 1.0 kg/ha PRE followed by hand weeding at 20 DAS. Lowest weed density, lowest Weed dry weight and highest Weed control efficiency were observed with 40 cm + Weed free check (1.72 /m², 1.64 g/m² and 98.63%) followed by Atrazine a.i. @ 1.0 kg/ha PRE + Tembotrione a.i. @ 120 g/ha PoE (4.03/m², 3.72 g/m² and 91.63 %) and Atrazine a.i. @ 1.0 kg/ha PRE followed by Hand weeding at 20 DAS (4.24/m², 5.27 g/m² and 85.12 %). Whereas lowest Weed index was observed with 40 cm + Weed free check ( 0 %), followed by 40 cm + Atrazine a.i. @ 1.0 kg/ha PRE followed by Hand weeding at 20 DAS (3.50 %) and Atrazine a.i @ 1.0 kg/ha PRE + Tembotrione a.i @ 120 g/ha PoE (10.15 %).

**Keywords**
Sweet corn, Rabi, Atrazine, Tembotrione, Weed control efficiency, Weed index, Weed density, Weed dry weight, Row-spacing

**Article Info**
Accepted: 28 November 2020
Available Online: 10 December 2020

**Introduction**
Sweet corn (Zea mays corn var. saccharata) is a variety of maize with high sugar content. Sweet corn is gradually becoming an important vegetable crop in India, as it forms a useful ingredient in the preparation of salad and other food ingredient both at home and in hotels. Sweet corn is one type of maize and contains 13 to 15% sugar in immature grains. Among agronomic practices, which affect the yield, inter row spacing has a special significance since it is ultimately related with plant population, root development, plant growth and fruiting (Davi et al., 1995). Generally, the most appropriate spacing is one, which enables the plants to make the best use of the conditions at their disposal (Lawson and Topham, 1985; Malik et al., 1993). Too close spacing interferes with normal plants development and increase competition resulting in yield reduction, while...
too wide spacing may result in excessive vegetative growth of plant and abundant weed population due to more feeding area available. Optimum spacing allows for easy of field operations and minimizes competition among plants for light, water, and nutrients. Narrow rows make more efficient use of available light and also shade the surface soil more completely during the early part of the season while the soil is still moist.

Although maize (*Zea mays* L.) plant is vigorous and tall growing in nature, yet it is very sensitive to weed competition at early stages of growth (Mabasa *et al.*, 1996; Kumar and Sundari, 2002). The commonly reported losses due to weeds in maize are greater than 30% (Rehman, 1985). Uncontrolled weeds may reduce maize yield as much as 90% (Madrid and Vega, 1976). Weed management can be formulated to minimize the losses due to weeds by means of integrated approach strategy. Manual weeding alone is not sufficient to ensure adequate weed control in maize field. It should be supplemented with chemical or herbicide for effective weed control. Use of Pre-emergence and post-emergence application of herbicides would make herbicidal weed control more acceptable to farmers which will not change the existing agronomic practices but will allow for complete control of weeds. Usage of Pre-emergence herbicides assumes greater importance in the view of their effectiveness from initial stages.

Pre-emergence herbicides ensure significant promising weed control and save crop from initial weed competition and nutrient drain. Similarly, the post emergence herbicide also has a significant role in reducing the crop weed competition at the time of critical growth stages of the crop. As the weeds interfere during the harvesting of the crop, post-emergence herbicides at about 40-45 DAS may help in avoiding the problem of weeds at later stages.

**Materials and Methods**

The experiment was conducted during the Rabi season of 2019 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (U.P.) India. Soil was sandy clay loam having pH 7.2, organic carbon around 0.42%, available nitrogen at 245 kg ha⁻¹, available P₂O₅ at 14.8 kg ha⁻¹ and K₂O at 343.2 kg ha⁻¹. The experiment was laid out in Randomized Block Design consisting of 10 treatment combinations each replicated three times. Different Row spacings i.e. 40 cm (S₁) and 50 cm (S₂) and Weed Management Practices (Weedy check (W₁), Weed free check (W₂), Atrazine a.i @ 1.0 kg/ha PRE fb Hand weeding at 20 DAS (W₃), Tembotrione a.i @ 120 g/ha PoE (W₄) and Atrazine a.i @ 1.0 kg/ha PRE fb Tembotrione a.i @ 120 g/ha PoE (W₅). Treatments were randomly arranged in each replication. Sugar-75 was sown at 20 cm plant spacing and row spacing as per the treatment.

Recommended doses of nitrogen, phosphorous and potassium were applied. The weeds collected from two randomly selected quadrates (0.5 m x 0.5 m) were used to estimate the dry matter of weeds. Observations were recorded at 20, 40, 60, 80, 100, at harvest. Pre-emergence application of herbicides was done one d (x+1) sowing while post-emergence herbicide was applied at 20 days after sowing. Total weed density was transformed using square root transformation \( \sqrt{\frac{x+1}{x}} \) for the statistical analysis. All the data were analyzed statistically by Fisher’s least significant difference method at 5% level of significance using IBM SPSS 24.0 software package developed by IBM Crop. (2016). Data on different growth parameters, yield attributes and yield were recorded from randomly selected ten tagged plants from net plot.
Results and Discussion

Growth parameters

Plant height

At Harvest, maximum plant height was obtained with the application of 50 cm + Weed free check (158.6 cm), which was statistically at par with 50 cm + Atrazine a.i @ 1.0 kg/ha PRE followed by Hand weeding at 20 DAS (157.96 cm). Significantly higher plant height in lower density (wider spacing) might be due to greater light interception, efficient utilization of soil moisture under lower degree of inter-plant competition. These results are in conformity with observation of Thakur et al., (1991) and Gollar and Patil (2000). Significantly higher plant height in weed free check might be due to better availability of moisture, nutrient, light and space to the crop owing to less weeds in this treatment. These results are in conformity with observation of Thakur et al., (1991) and Gollar and Patil (2000). The lowest plant height in weedy check might be due to more competition between crop and weed for moisture nutrient, light and space. These results are in conformity with observation of Kotru et al., (2012) (Table 1).

Plant dry weight

At harvest, maximum plant dry weight was obtained with the application of 40 cm + Weed free check (212.55 g/plant), which was statistically at par with 50 cm + Weed free check (210.09 g/plant) and 50 cm + Atrazine a.i @ 1.0 kg/ha PRE followed by Hand weeding at 20 DAS (209.66 g/plant) reducing plant population might be due to increase in plant growth, ultimately lead to production of more photosynthates. These results are in conformity with the results of Thakur et al., (1991) and Gollar and Patil (2000). Increase in plant dry weight might be due to better availability of moisture, nutrient, light and space to the crop owing to less weeds in this treatment. These results are in conformity with observation of Thakur et al., (1991) and Gollar and Patil (2000).

Yield parameters

Cobs/plant

Maximum no. of cobs/plant obtained with the application of 50 cm + Weed free check (1.28 cobs/plant) which was statistically at par with 50 cm + Atrazine a.i @ 1.0 kg/ha PRE followed by hand weeding at 20 DAS (1.26 cobs/plant). Highest no. of cobs/plant with 50 cm x 20 cm row spacing might be due to less competition for space, moisture and nutrients which accelerate normal photosynthesis activity owing to more interception of sunlight. These findings are sustained with those reported by Bhatt (2012) and Golada et al., Highest no. of cobs/plant with weed free check might be due to significant reduction in crop weed competition due to effective control of weeds under this treatment reflected in better growth and development of the crop. These results are in close conformity with the findings of Nadiger et al., (2013) and Mathukia et al., (2014).

Green cob yield

Maximum green cob yield was obtained with the application of 40 cm + Weed free check (10.51 t/ha) which was significantly superior over rest of the treatments except with 40cm x 20cm + Atrazine a.i @ 1 kg/ha PRE + Hand weeding at 20 DAS (10.48 t/ha) which was statistically at par with 40 cm + Weed free check. Higher the crop spacing higher the crop population utilized the production resources more efficiently towards plant development. These findings are in agreement with those of Kar et al., (2006). Higher green cob yield with weed free check might be due
to significant reduction in crop weed competition due to effective control of weeds under this treatment reflected in better growth and development of the crop. These results are in close conformity with the findings of Nadiger et al., (2013) and Mathukia et al., (2014).

**Stover yield**

Maximum stover yield obtained with the application of 40cm x 20cm + Atrazine a.i @ 1 kg/ha PRE + Hand weeding at 20 DAS (21.33 t/ha) which was significantly superior over rest of the treatments except with 40 cm + Weed free check (21.25 t/ha) which was statistically at par with 40cm x 20cm + Atrazine a.i @ 1 kg/ha PRE + Hand weeding at 20 DAS. The remarkable increase in stover yield under 40 cm + weed free was mainly due to increased plant population these results are in accordance with those of Thakur et al., (1991) Sukanya et al., (2000) and Bhatt (2012).

**Weed studies**

**Weed density**

At harvest, the lowest weed density (2.46/m²) was observed in treatment 40 cm + weed free check followed by 50 cm + Weed free check (3.04/m²). Besides, weed free check the lowest weed density was followed by 40 cm + Atrazine a.i @ 1.0 kg/ha PRE fb Tembotrione a.i @ 120 g/ha PoE (15.78/m²). The highest weed density resulted in weedy check due to high weed crop competition for nutrients, space, sunlight, carbon dioxide and water which hampered crop growth that resulted in low yield. Similar results were reported by (Sreenivas and Satyanarayana, 1996) and (Mundra et al., 2002) (Table 2).

**Table.1 Effect of row-spacing and weed management practices on growth and yield of Sweet corn**

| Treatment combinations            | Plant Height (cm) | Dry weight (g/plant) | No. of cobs/plant | Green cob yield (t/ha) | Stover Yield (t/ha) |
|-----------------------------------|-------------------|----------------------|------------------|------------------------|---------------------|
| 40cm x 20 cm + Weedy check        | 134.33            | 182.51               | 1.05             | 7.85                   | 17.23               |
| 40cm x 20 cm + Weed free check    | 157.03            | 212.55               | 1.15             | 10.51                  | 21.25               |
| 40cm x20cm + Atrazine a.i @ 1 kg/ha fb Hand weeding at 20 DAS | 149.2            | 203.35               | 1.16             | 10.48                  | 21.33               |
| 40cm x20cm + Tembotrione a.i @ 120 g/ha at 20DAS | 136.66          | 184.21               | 1.09             | 9.39                   | 18.42               |
| 40cm x20cm + Atrazine a.i @ 1 Kg/ha fb Tembotrione a.i @ 120 g/ha | 141.93          | 198.62               | 1.09             | 9.49                   | 19.86               |
| 50cm x 20 cm + Weedy check        | 135.63            | 183.23               | 1.16             | 6.72                   | 14.65               |
| 50cm x 20 cm + Weed free check    | 158.6             | 210.09               | 1.28             | 9.93                   | 16.80               |
| 50cm x 20 cm + Atrazine a.i @ 1 kg/ha fb Hand weeding at 20 DAS | 157.96          | 209.66               | 1.26             | 8.94                   | 16.77               |
| 50cm x20cm + Tembotrione a.i @ 120 g/ha at 20DAS | 156.6           | 208.42               | 1.16             | 8.20                   | 16.67               |
| 50cm x20cm + Atrazine a.i @ 1 Kg/ha fb Tembotrione a.i @ 120g/ha | 156.63          | 208.49               | 1.25             | 8.91                   | 16.67               |
| SEm±                              | 0.74              | 2.10                 | 0.018            | 0.13                   | 0.21                |
| CD (P=0.05)                       | 2.2               | 6.25                 | 0.05             | 0.39                   | 0.64                |
Table 2 Effect of row-spacing and weed management practices on weed studies of Sweet corn

| Treatment combinations | Weed Density (/m²) | Weed Dry weight (g/m²) | Weed Control Efficiency (%) | Weed Index (%) |
|------------------------|--------------------|------------------------|----------------------------|---------------|
| 40cm x 20 cm + Weedy check | 11.18(124.59) | 161.60 | 0 | 24.46 |
| 40cm x 20 cm + Weed free check | 1.72(2.46) | 2.20 | 98.63 | 0 |
| 40cm x20cm + Atrazine a.i @ 1 kg/ha fb Hand weeding at 20 DAS | 4.24(17.53) | 27.29 | 85.12 | 3.50 |
| 40cm x20cm + Tembotrione a.i @ 120 g/ha at 20DAS | 5.20(26.58) | 36.38 | 77.47 | 12.06 |
| 40cm x20cm + Atrazine a.i @ 1 Kg/ha fb Tembotrione a.i @ 120 g/ha | 5.03(15.78) | 13.36 | 91.63 | 11.16 |
| 50cm x 20 cm + Weedy check | 11.36(128.6) | 166.10 | 0 | 32.28 |
| 50cm x 20 cm + Weed free check | 1.88(3.04) | 2.50 | 98.49 | 0 |
| 50cm x 20 cm + Atrazine a.i @ 1 kg/ha fb Hand weeding at 20 DAS | 4.32(18.23) | 31.81 | 80.84 | 10.00 |
| 50cm x20cm + Tembotrione a.i @ 120 g/ha at 20DAS | 5.49(29.66) | 39.64 | 76.12 | 19.02 |
| 50cm x20cm + Atrazine a.i @ 1 Kg/ha fb Tembotrione a.i @ 120g/ha | 4.09(16.24) | 16.57 | 90.01 | 10.15 |
| SEM± | 0.22 | 1.82 | 0.21 | 1.09 |
| CD (P=0.05) | 0.67 | 5.43 | 0.64 | 3.24 |

Note: Figure in paranthesis are original values

Weed dry weight

At Harvest, the lowest weed dry weight (2.20/m²) was observed in treatment 40 cm + weed free check followed by 50 cm + Weed free check (2.50/m²). Besides, weed free check the lowest weed density was followed by 40 cm + Atrazine a.i @ 1.0 kg/ha PRE fb Tembotrione a.i @ 120 g/ha PoE (13.36/m²). The minimum weed dry weight, might be due to effective control of weeds. In addition to this, dense crop canopy might have suppressed weed growth and ultimately less biomass. The weedy check recorded significantly highest weed dry weight owing to uncontrolled condition favored luxurious weed growth. These findings are in close conformity with those reported by Sinha et al., (2003), Kolage et al., (2004) and Verma et al., (2009).

Weed control efficiency

At harvest, maximum weed control efficiency (95.63%) observed in 40 cm + Atrazine a.i @ 1.0 kg/ha PRE fb Tembotrione a.i @ 120 g/ha PoE and 50 cm + Atrazine a.i @ 1.0 kg/ha PRE fb Tembotrione a.i @ 120 g/ha PoE (90.01%). However, lowest weed control efficiency (76.12%) observed in 50 cm + Tembotrione a.i @ 120 g/ha PoE. The maximum weed control efficiency, might be due to effective control wees under. In addition to this, dense crop canopy might have suppressed weed growth and ultimately less biomass. The weedy check recorded significantly lowest control efficiency owing to uncontrolled condition favored luxurious weed growth. These findings are in close conformity with those reported by Sinha et al., (2003), Kolage et al., (2004) and Verma et al., (2009).

Weed index

At harvest, lowest weed index (3.50 %) observed in 40 cm + Atrazine a.i @ 1.0 kg/ha PRE fb Hand weeding at 20 DAS. However, highest weed index (32.28%) 40 cm + Weedy check. The minimum weed index in weed free and 40 cm + Atrazine a.i @ 1.0 kg/ha PRE fb
Hand weeding at 20 DAS might be due to effective control weeds under these treatments. In addition to this, dense crop canopy might have suppressed weed growth and ultimately less biomass. The weedy check recorded significantly highest weed index owing to uncontrolled condition favored luxurious weed growth. These findings are in close conformity with those reported by Sinha et al., (2003), Kolage et al., (2004) and Verma et al., (2009).

Based on experimental findings it may be concluded that besides weed free check, lowest weed density and weed control efficiency were observed with the application of 40 cm + Atrazine a.i @ 1 Kg/ha PRE fb Tembotrione 120 g/ha PoE and highest green cob yield was maximum with the application of 40cm + Atrazine a.i @ 1 kg/ha PRE fb Hand weeding at 20 DAS. Since these findings are based on research done in one season under agro - ecological conditions of Allahabad it may be repeated for confirmation.

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**How to cite this article:**

Bajeetunnisa, Rajesh Singh and Ekta Singh. 2020. Effect of Row-spacing and Weed Management Practices on Growth and Yield of Sweet Corn (*Zea mays* L. *saccharata*). *Int.J.Curr.Microbiol.App.Sci*. 9(12): 3403-3409. doi: https://doi.org/10.20546/ijcmas.2020.912.404