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# Effect of Various Weed Management Options on Weed Dry Matter, Yield Attributes and Yield of Sweet Corn (*Zea mays* L. *saccharata*) under Organic Production System

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***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

A field experiment was conducted at Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during *kharif* 2019 entitled **"**Effect of various weed management options on weed dry matter, yield attributes and yield of sweet corn (*Zea mays* L. *saccharata*) under organic production system". The soil of the experimental site was clayey in texture, neutral in reaction and low in nitrogen, medium in phosphorus and high in potassium. The experiment was laid out in Randomized Block Design with three replications. The weed flora of the experimental site

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was dominated by *Echinocloa colona, Alternanthera sessilis*, *Parthenium hysterophorus*, *Cyperus iria*. Results revealed that the highest green cob yield of sweet corn was recorded in stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + 20 DAS hand weeding (7.63t $ha^{-1}$ ) which was 83.48% higher than the weedy check. The green cob yield in stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + 20 DAS hand weeding was found to be at par with mulching with waste polythene bags (ITK-practices) (7.45t $ha^{-}$ ), hand weeding twice carried out at 20 and 40 DAS (7.33 t $ha^{-1}$) and soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS(6.94t $ha^{-1}$). Although grain yield in other weed management practices was significantly lower than stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + 20 DAS hand weeding treatments but higher than weedy check. Similarly, As regards total weed dry weight at harvest, the total lowest weed dry weight was observed in stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS(3.45$gm^{-2}$) followed by mulching with waste polythene bags (ITK- practices)(4.71 $gm^{-2}$), hand weeding at 20 and 40 DAS (4.96$gm^{-2}$)and soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS(5.08 $gm^{-2}$). However, higher WCE was noticed in these treatment over weedy check. The weedy check was significantly inferior in all the yield attributes and green cob yield of sweet corn.

*Keywords: Stale seed bed**;** sweet corn (Zea mays L. saccharata); weed dry matter; weed control efficiency.*

## 1. INTRODUCTION

"In the world Maize (*Zea mays*) is a very important crop. After rice and wheat maize keeps third position in crops. Maize was a first cereal grain which to be domesticated by indigenous peoples in southern Mexico about 10,000 years ago. Corn is the very important food of a wide population of the world's communities and one of the economically main crops in the world" [1,2-5]. Maize is generally grown early for grain purpose and in the second for fodder. It has potential for high production; there isn't a cereal with as much potential as maize, it is referred to as the "Queen of Cereals." "Even at higher radiation intensities, maize uses sun radiation quite effectively. With all of these qualities, maize is a "miracle crop." Maize is grown in 9380 thousand hectare area in India and its production is 28753 thousand tonne with productivity of 3065 kg/ha" (Indiastat, 2017-18). "Maize is grown in 133.41 thousand hectare with production and productivity of 317.52 thousand tonne & 2380 kg $ha^{-1}$ respectively in Chhattisgarh" (Indiastat, 2017-18).

"Maize and weeds emerge at the same time during the *Kharif* season, with the first 20 to 30 days being especially important for crop-weed competition. Depending on the weed population, flora, and length of crop-weed competition, maize yield drop can range from 28 to 93%. Weeds may be effectively controlled at a reasonable cost by hand weeding at 20 and 40 DAS" [6,7-9]. Weeds compete with the crop plants for sunlight, moisture and nutrients [10], Saeed et al. 2013) and deprive the crops from vital resources (Lehocky and Reisinger 2003). During the kharif season, maize experiences a severe weed invasion because of its widely scattered crop [11-13,14-17]. The goal of the study was to identify a cost-effective weed-control strategy that would increase the profitability and production of *kharif* sweet corn.

## 2. MATERIALS AND METHODS

The study was carried out during *kharif* season of 2019-2020. The experiment site was located at the Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G.). "The type of soil in experiment field was clayey soil in texture with containing low nitrogen, medium phosphorus and high potassium. Sweet corn variety 'sugar-75' was used in the experiment. The mean temperature ranged from 24.16ºC to 35.67ºC during *kharif* season. The crop was sown on 15$^{th}$ July with the seed rate 3.5 kg $ha^{-1}$at spacing of 60cm × 20cm except 4.5 kg $ha^{-1}$ with spacing 45cm × 20 cm in stale seed bed + reduced spacing (up to 25%) + mulching with paddy straw + hand weeding at 20 DAS($W_4$). Standard organic package of practices was followed through the cropping season. The crop was harvested on 2$^{nd}$ and 10$^{th}$ October. The field experiment was carried out in randomized block design with three replications. The treatment comprised of nine weed management

practices $W_1$- Hand weeding at 20 and 40 DAS, $W_2$- One mechanical weeding at 20 DAS + one hand weeding at 40 DAS, $W_3$ -Intercropping with black gram(1:1), $W_4$- Stale seed bed + reduced spacing (up to 25%) + mulching with paddy straw + hand weeding at 20 DAS, $W_5$- Locally available weed mulch (*Lantana camara*) + one hand pulling at 20 DAS, $W_6$- Incorporation of neem cake 15 days before sowing, @ 5 tonnes/ha + hand weeding at 20 DAS, $W_7$-Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS, $W_8$- Mulching with waste polythene bags (ITK- practices) and $W_9$ -Weedy check. The plot size was 5.40 m × 4.20m(22.68$m^2$)" [1].

Soil solarization in summer season, stale seed bed prepared before 20 days of sowing and neem cake was applied before 15 day of sowing. Weeding was done by labour and hoe. In manual weed control weeds were uprooted and removed at 20 and 40 DAS as per the treatment. In weedy check there was no weeding practices applied.

"Growth and yield attributes like plant height, dry matter accumulation, number of leaf, and yields parameters were noted at harvest of the crop. Weed density (grasses, broad leaf and sedges) was counted at 20, 40 ,60 and at harvest using 0.25$m^2$ quadrate from each plot. Weeds which were found in the quadrate were carefully uprooted along with the roots. The roots of the samples were cut and only the aerial parts were cleaned, sum-dried and finally oven-dried at 60ºC for 48 hours. The dry matter was noted species wise and total dry matter expressed as $gm^{-2}$. Weed control efficiency and weed index (WI) were calculated by the formulae" suggested by Mani et al. (1973).

Weed control efficiency (WCE%) = (DWC - DWT) / (DWC) X 100

Where,

WCE =Weed control efficiency(%)
DWC =Dry weight of weeds in weedy check plot
DWT = Dry weight of weeds in treated plot

Weed index was expressed in % and worked out by using the formula given below(Gill and Kumar, 1969).

Weed index (%) = (Maximum cob yield – Cob yield from treated plot) / (Maximum cob yield) X100

"The data obtained on various parameters were tabulated and subjected to statistical analysis. The data on weed density and dry matter production of weed was subjected to square root transformation i.e. before carrying analysis of variance. The levels of treatment was tested with 'F' test shown their significance, the levels of treatment were compared by critical difference at 5% level of probability. The skeleton of analysis of variance and formula used for various estimations are given below" [18]. Gross return (money income from cob and stover yields), net returns (monetary income obtained after deducting cost of cultivation from gross returns) and B:C ratio (gross returns divided by cost of cultivation) were calculated using prevailing market price of inputs (including treatments), labours and produce for assessing the economic viability of treatments.

## 3. RESULTS AND DISCUSSION

### 3.1 Weed Flora

The weed flora in the experiment site constituted by grass *viz*., *Echinocloa colona,* broad leaf weed *viz., Alternanthera sessilis*, *Parthenium hysterophorus*, Sedges *viz.,Cyperus iria* and others weed *spp*.

### 3.2 Crop Growth and Yield

Growth and yield attributes as well as cob and stover yield were significantly influenced by different weed control measures (Table 1). "Result recorded that significantly the highest cob length (17.09 cm), cob diameter (4.20cm), number of cobs per plant (1.60), Cob weight (164.4g), number of rows $cob^{-1}$ (15.5),number of grain $rows^{-1}$ (32.1), number of grains $cob^{-1}$ (489.0), green cob yield(7.63t $ha^{-1}$) and stover yield(19.03t $ha^{-1}$)) were recorded in stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + 20 DAS hand weeding which was found at par with in mulching with waste polythene bags (ITK-practices), hand weeding at 20 and 40 DAS and soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS" [1]. The improved growth and yield attributes under these treatments might be due to stale seed bed, paddy straw mulching

**Table 1. Plant growth parameters of *kharif* sweet corn as influenced by various weed management practices at different time interval**

| Treatments | Plant height ( cm) | | | | Dry matter accumulation ( g plant$^{-1}$) | | | | Number of leaf plant$^{-1}$ | | | | Leaf area(cm$^2$ plant$^{-1}$) | | | | Leaf area index | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20 DAS | 40 DAS | 60 DAS | AH | 20 DAS | 40 DAS | 60 DAS | AH | 20 DAS | 40 DAS | 60 DAS | AH | 20 DAS | 40 DAS | 60 DAS | AH | 20 DAS | 40 DAS | 60 DAS | AH |
| $W_1$ | 22.1 | 93.4 | 154.7 | 174.3 | 5.4 | 23.2 | 85.0 | 158.5 | 4.40 | 6.23 | 11.93 | 6.77 | 158.5 | 1169.2 | 1445.4 | 1205.6 | 0.13 | 0.97 | 1.20 | 1.01 |
| $W_2$ | 21.6 | 90.4 | 149.8 | 167.7 | 5.3 | 21.4 | 80.3 | 150.4 | 4.37 | 6.20 | 10.23 | 6.17 | 154.3 | 1130.1 | 1343.2 | 1140.9 | 0.13 | 0.94 | 1.12 | 0.95 |
| $W_3$ | 20.7 | 83.7 | 120.9 | 127.4 | 4.7 | 18.7 | 58.6 | 104.1 | 4.33 | 5.53 | 9.93 | 5.22 | 153.2 | 958.4 | 1056.2 | 998.4 | 0.13 | 0.8 | 0.88 | 0.83 |
| $W_4$ | 22.4 | 94.1 | 160.8 | 181.9 | 6.4 | 25.8 | 90.2 | 165.4 | 4.49 | 6.50 | 12.27 | 7.73 | 159.7 | 1223.2 | 1469.5 | 1256.4 | 0.18 | 1.36 | 1.63 | 1.40 |
| $W_5$ | 21.8 | 90.3 | 137.7 | 161.4 | 5.1 | 20.0 | 68.5 | 124.7 | 4.33 | 6.00 | 9.13 | 5.40 | 156.9 | 1001.7 | 1111.2 | 1030.0 | 0.13 | 0.83 | 0.92 | 0.86 |
| $W_6$ | 21.3 | 90.4 | 143.6 | 168.0 | 5.2 | 22.0 | 72.8 | 132.3 | 4.33 | 6.20 | 9.67 | 5.93 | 155.2 | 1029.1 | 1126.5 | 1040.4 | 0.13 | 0.86 | 0.94 | 0.87 |
| $W_7$ | 21.3 | 92.0 | 153.8 | 173.5 | 5.5 | 22.2 | 83.8 | 155.7 | 4.27 | 6.20 | 11.67 | 6.57 | 157.6 | 1152.8 | 1443.8 | 1203.8 | 0.13 | 0.96 | 1.21 | 1.01 |
| $W_8$ | 22.3 | 94.0 | 157.7 | 176.8 | 5.9 | 25.1 | 87.8 | 161.3 | 4.40 | 6.47 | 12.07 | 7.03 | 159.4 | 1217.7 | 1453.8 | 1230.7 | 0.13 | 1.01 | 1.21 | 1.02 |
| $W_9$ | 20.5 | 56.9 | 103.5 | 110.2 | 5.3 | 16.6 | 50.6 | 89.5 | 4.30 | 5.20 | 9.07 | 5.23 | 153.5 | 775.7 | 963.4 | 792.0 | 0.13 | 0.64 | 0.8 | 0.66 |
| SEm ± | 0.33 | 1.04 | 2.39 | 2.84 | 0.35 | 0.45 | 2.91 | 3.24 | 0.12 | 0.16 | 0.45 | 0.39 | 3.70 | 46.2 | 36.4 | 37.5 | 0.00 | 0.04 | 0.03 | 0.03 |
| CD(P=0.05) | 0.99 | 3.10 | 7.18 | 8.52 | 1.04 | 1.36 | 8.72 | 9.72 | NS | 0.48 | 1.36 | 1.18 | NS | 138.52 | 109.21 | 112.51 | 0.01 | 0.12 | 0.10 | 0.09 |

**Table 2. Yield parameters of *kharif* sweet corn as influenced by various weed management practices at different time interval**

| Treatments | Number of cob palnt$^{-1}$ | Cob length (cm) | Green cob diameter (cm) | Cob weight (g) | Number of row cob$^{-1}$ | Number of grain row$^{-1}$ | Number of grains cob$^{-1}$ | Green cob yield (t ha$^{-1}$) | Stover yield (t ha$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| $W_1$- HW at 20 and 40 DAS | 1.5 | 16.5 | 4.1 | 157.2 | 15.4 | 28.6 | 477.3 | 7.33 | 17.52 |
| $W_2$-1MW at 20 DAS + 1HW at 40DAS | 1.3 | 13.7 | 3.7 | 145.2 | 14.3 | 27.6 | 425.6 | 6.37 | 15.06 |
| $W_3$- IC with black gram(1:1) | 1.1 | 10.5 | 3.6 | 92.5 | 12.1 | 23.7 | 313.6 | 4.97 | 11.37 |
| $W_4$- SSB+RS (upto 25%)+ MPS +HW at 20 DAS | 1.6 | 17.1 | 4.2 | 164.4 | 15.5 | 32.2 | 489.0 | 7.63 | 19.03 |
| $W_5$- WM+ 1HP at 20 DAS- | 1.2 | 12.7 | 3.7 | 112.7 | 13.2 | 25.8 | 380.5 | 5.86 | 13.10 |
| $W_6$- ICP NC + HW at 20 DAS | 1.3 | 13.1 | 3.7 | 138.4 | 13.3 | 26.1 | 391.6 | 5.88 | 13.28 |
| $W_7$- SS + 1 HW at 20 DAS | 1.5 | 16.1 | 4.0 | 154.4 | 14.8 | 27.9 | 449.1 | 6.94 | 15.91 |
| $W_8$- (ITK-practices) | 1.5 | 16.6 | 4.2 | 160.6 | 15.4 | 31.4 | 483.7 | 7.45 | 17.81 |
| $W_9$- Weedy check | 1.0 | 7.3 | 3.3 | 73.5 | 11.6 | 18.0 | 212.7 | 1.26 | 2.80 |
| SEm ± | 0.05 | 0.34 | 0.13 | 3.39 | 0.25 | 1.51 | 14.47 | 0.35 | 1.05 |
| CD(P=0.05) | 0.15 | 1.01 | 0.38 | 10.45 | 0.75 | 4.53 | 43.38 | 1.05 | 3.15 |

**Table 3. Weed dry weight of *kharif* sweet corn as influenced by various weed management practices at 20 DAS**

| Treatments | Weed dry weight ($gm^{-2}$), 20 DAS | | | | | |
|---|---|---|---|---|---|---|
| | ***Echinochloa colona*** | ***Alternanthera sessilis*** | ***Parthenium hysterophorus*** | ***Cyperus Iria*** | **Others** | **Total** |
| $W_1$-Hand weeding at 20 and 40 DAS. | 2.62 (6.38) | 2.47 (5.62) | 2.40 (5.28) | 2.98 (8.39) | 1.94 (3.29) | 5.42 (28.96) |
| $W_2$-One mechanical weeding at 20 DAS + one hand weeding at 40DAS. | 2.14 (4.10) | 2.14 (4.10) | 2.18 (4.27) | 3.17 (9.59) | 2.38 (5.20) | 5.26 (27.26) |
| $W_3$-Intercropping with black gram(1:1). | 1.72 (2.47) | 2.08 (3.84) | 2.12 (4.02) | 2.03 (3.63) | 2.42 (5.38) | 4.45 (19.34) |
| $W_4$-Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS. | 0.98 (0.48) | 1.21 (0.98) | 1.09 (0.69) | 1.00 (0.52) | 1.24 (1.05) | 2.05 (3.72) |
| $W_5$-Locally available weed mulch (*Lantana camara*) + one hand pulling at 20 DAS. | 2.01 (3.57) | 1.97 (3.40) | 2.16 (4.20) | 2.09 (3.90) | 2.18 (4.27) | 4.45 (19.34) |
| $W_6$-Incorporation of neem cake 15 days before sowing, 5 tonnes $ha^{-1}$+ hand weeding at 20 DAS. | 2.07 (3.79) | 1.94 (3.27) | 2.13 (4.05) | 2.07 (3.82) | 2.21 (4.40) | 4.45 (19.33) |
| $W_7$-Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS. | 1.59 (2.03) | 1.68 (2.33) | 1.87 (3.02) | 1.59 (2.04) | 1.70 (2.40) | 3.53 (12.00) |
| $W_8$-Mulching with waste polythene bags (ITK-practices). | 1.30 (1.20) | 1.54 (1.90) | 1.21 (0.98) | 1.34 (1.31) | 1.34 (1.30) | 2.68 (6.69) |
| $W_9$-Weedy check. | 2.28 (4.73) | 2.48 (5.67) | 2.18 (4.26) | 2.98 (8.40) | 3.13 (9.30) | 5.73 (32.36) |
| SEm± | 0.13 | 0.12 | 0.15 | 0.15 | 0.10 | 0.09 |
| CD (P=0.05) | 0.39 | 0.36 | 0.45 | 0.46 | 0.30 | 0.27 |

*Note* Data in parenthesis are pre transformed originals value, which were transformed to (√x+0.5) and analysed statistically*

**Table 4. Weed dry weight of kharif sweet corn as influenced by various weed management practices at 40 DAS**

| Treatments | Weed dry weight ($gm^{-2}$), 40 DAS | | | | | |
|---|---|---|---|---|---|---|
| | ***Echinochloa Colona*** | ***Alternanthera sessilis*** | ***Parthenium hysterophorus*** | ***Cyperusiria*** | **Others** | **Total** |
| $W_1$-Hand weeding at 20 and 40 DAS. | 1.54 (1.89) | 1.46 (1.66) | 1.93 (3.24) | 2.12 (4.01) | 1.92 (3.20) | 3.8 (14.00) |
| $W_2$-One mechanical weeding at 20 DAS + one hand weeding at 40DAS. | 1.93 (3.26) | 1.42 (1.53) | 1.91 (3.17) | 2.21 (4.39) | 1.86 (2.96) | 3.97 (15.31) |
| $W_3$-Intercropping with black gram(1:1). | 2.97 (8.38) | 2.81 (7.42) | 2.57 (6.13) | 2.53 (5.95) | 3.18 (9.63) | 6.16 (37.51) |
| $W_4$-Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS. | 0.91 (0.33) | 1.03 (0.58) | 1.03 (0.57) | 0.96 (0.43) | 1.21 (0.97) | 1.83 (2.88) |
| $W_5$-Locally available weed mulch (*Lantana camara*) + one hand pulling at 20 DAS. | 1.72 (2.47) | 1.59 (2.03) | 1.62 (2.15) | 1.85 (2.94) | 2.16 (4.18) | 3.77 (13.77) |
| $W_6$-Incorporation of neem cake 15 days before sowing,5 tonnes $ha^{-1}$ + hand weeding at 20 DAS. | 1.69 (2.38) | 1.56 (1.95) | 1.59 (2.03) | 1.44 (1.59) | 2.14 (4.09) | 3.54 (12.04) |
| $W_7$-Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS. | 1.49 (1.73) | 1.60 (2.09) | 1.60 (2.07) | 1.55 (1.93) | 1.62 (2.14) | 3.23 (9.96) |
| $W_8$-Mulching with waste polythene bags (ITK-practices). | 1.46 (1.64) | 1.74 (2.56) | 1.56 (1.94) | 1.56 (1.96) | 1.67 (2.31) | 3.3 (10.41) |
| $W_9$-Weedy check. | 3.84 (14.32) | 3.23 (9.97) | 2.98 (8.39) | 3.80 (13.97) | 4.78 (22.4) | 8.33 (69.05) |
| SEm± | 0.13 | 0.15 | 0.13 | 0.12 | 0.12 | 0.11 |
| CD (P=0.05) | 0.39 | 0.44 | 0.39 | 0.39 | 0.36 | 0.33 |

*Note* Data in parenthesis are pre transformed originals value, which were transformed to ($\sqrt{x+0.5}$) and analysed statistically*

**Table 5. Weed dry weight of *kharif* sweet corn as influenced by various weed management practices at 60 DAS**

| Treatments | Weed dry weight($gm^{-2}$), 60 DAS | | | | | |
|---|---|---|---|---|---|---|
| | ***Echinochloa colona*** | ***Alternanthera sessilis*** | ***Parthenium hysterophorus*** | ***Cyperusiria*** | **Others** | **Total** |
| $W_1$-Hand weeding at 20 and 40 DAS. | 1.93 | 1.64 | 2.08 | 1.72 | 1.30 | 3.67 |
| | (3.25) | (2.19) | (3.86) | (2.48) | (1.19) | (12.97) |
| $W_2$-One mechanical weeding at 20 DAS + one hand weeding at 40DAS. | 1.78 | 1.67 | 2.04 | 1.76 | 1.74 | 3.78 |
| | (2.69) | (2.31) | (4.69) | (2.61) | (2.55) | (13.80) |
| $W_3$-Intercropping with black gram(1:1). | 3.98 | 3.71 | 3.92 | 3.35 | 6.21 | 9.64 |
| | (15.38) | (13.30) | (14.93) | (10.74) | (38.16) | (92.51) |
| $W_4$-Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw+hand weeding at 20 DAS. | 1.06 (0.64) | 1.30 (1.20) | 1.31 (1.24) | 1.09 (0.69) | 1.43 (1.56) | 2.41 (5.33) |
| $W_5$-Locally available weed mulch (*Lantana camara*) + one hand pulling at 20 DAS. | 2.07 | 2.18 | 2.48 | 2.10 | 2.53 | 4.91 |
| | (3.79) | (4.29) | (5.70) | (3.93) | (5.94) | (23.65) |
| $W_6$-Incorporation of neem cake 15 days before sowing, 5 tonnes $ha^{-1}$+ hand weeding at 20 DAS. | 1.78 | 2.10 | 2.42 | 1.82 | 2.44 | 4.56 |
| | (2.69) | (3.93) | (5.37) | (2.84) | (5.49) | (20.32) |
| $W_7$-Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS. | 1.64 | 1.94 | 2.19 | 1.88 | 2.10 | 4.07 |
| | (2.20) | (3.27) | (4.30) | (3.04) | (3.94) | (16.09) |
| $W_8$-Mulching with waste polythene bags (ITK-practices). | 1.67 | 1.86 | 1.87 | 1.74 | 2.00 | 3.85 |
| | (2.30) | (2.97) | (3.01) | (2.53) | (3.53) | (14.30) |
| $W_9$-Weedy check. | 4.34 | 3.74 | 3.84 | 4.67 | 7.59 | 11.19 |
| | (18.40) | (13.53) | (14.26) | (21.35) | (57.23) | (124.77) |
| SEm± | 0.12 | 0.14 | 0.10 | 0.15 | 0.18 | 0.26 |
| CD (P=0.05) | 0.37 | 0.43 | 0.31 | 0.44 | 0.55 | 0.77 |

*Note* Data in parenthesis are pre transformed originals value, which were transformed to ($\sqrt{x+0.5}$) and analysed statistically*

**Table 6. Weed dry weight of *kharif* sweet corn as influenced by various weed management practices at harvest**

| Treatments | Weed dry weight($gm^{-2}$), at harvest | | | | | |
|---|---|---|---|---|---|---|
| | ***Echinochloa colona*** | ***Alternanthera sessilis*** | ***Parthenium hysterophorus*** | ***Cyperusiria*** | **Others** | **Total** |
| W1-Hand weeding at 20 and 40 DAS. | 2.28 (4.70) | 2.40 (5.29) | 2.43 (5.42) | 2.14 (4.12) | 2.25 (4.59) | 4.96 (24.12) |
| W2-One mechanical weeding at 20 DAS + one hand weeding at 40DAS. | 2.32 (4.91) | 2.42 (5.39) | 3.47 (5.65) | 2.28 (4.73) | 2.29 (4.77) | 5.09 (25.45) |
| W3-Intercropping with black gram(1:1). | 5.36 (28.31) | 4.54 (20.19) | 4.78 (22.36) | 5.36 (28.33) | 6.46 (41.26) | 11.87 (140.45) |
| W4-Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS. | 1.23 (1.02) | 1.93 (3.25) | 2.04 (3.68) | 1.34 (1.31) | 1.64 (2.19) | 3.45 (11.45) |
| W5-Locally available weed mulch (*Lantana camara*) + one hand pulling at 20 DAS. | 2.55 (6.03) | 2.70 (6.84) | 2.80 (7.39) | 2.62 (6.39) | 2.81 (7.40) | 5.87 (34.05) |
| W6-Incorporation of neem cake 15 days before sowing, 5 tonnes $ha^{-1}$+ hand weeding at 20 DAS. | 2.49 (5.72) | 2.62 (6.37) | 3.03 (8.74) | 2.55 (6.04) | 2.55 (6.04) | 5.78 (32.91) |
| W7-Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS. | 2.29 (4.78) | 2.48 (5.69) | 2.47 (5.63) | 2.24 (4.56) | 2.28 (4.70) | 5.08 (25.36) |
| W8-Mulching with waste polythene bags (ITK-practices). | 2.19 (4.31) | 2.18 (4.29) | 2.42 (5.39) | 2.13 (4.05) | 2.13 (4.04) | 4.71 (22.08) |
| W9-Weedy check. | 4.67 (21.37) | 5.60 (30.92) | 5.47 (29.5) | 6.99 (48.39) | 8.05 (64.39) | 13.96 (194.57) |
| SEm± | 0.21 | 0.21 | 0.18 | 0.18 | 0.18 | 0.09 |
| CD (P=0.05) | 0.63 | 0.37 | 0.54 | 0.53 | 0.55 | 0.26 |

*Note* Data in parenthesis are pre transformed originals value, which were transformed to (√x+0.5) and analysed statistically*

**Table 7. Total weed dry weight of *kharif* sweet corn as influenced by various weed management practice at different time interval**

| Treatments | Total dry weight ($gm^{-2}$) | | | |
|---|---|---|---|---|
| | 20 DAS | 40 DAS | 60 DAS | At harvest |
| $W_1$-Hand weeding at 20 DAS and 40 DAS. | 5.42 | 3.8 | 3.67 | 4.96 |
| | (28.96) | (14.00) | (12.97) | (24.12) |
| $W_2$-One mechanical weeding at 20 DAS + one hand weeding at 40DAS. | 5.26 | 3.97 | 3.78 | 5.09 |
| | (27.26) | (15.31) | (13.80) | (25.45) |
| $W_3$-Intercropping with black gram(1:1). | 4.45 | 6.16 | 9.64 | 11.87 |
| | (19.34) | (37.51) | (92.51) | (140.45) |
| $W_4$-Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS. | 2.05 | 1.83 | 2.41 | 3.45 |
| | (3.72) | (2.88) | (5.33) | (11.45) |
| $W_5$-Locally available weed mulch (*Lantana camara*) + one hand pulling at 20 DAS. | 4.45 | 3.77 | 4.91 | 5.87 |
| | (19.34) | (13.77) | (23.65) | (34.05) |
| $W_6$-Incorporation of neem cake 15 days before sowing, 5 tonnes $ha^{-1}$+ hand weeding at 20 DAS. | 4.45 | 3.54 | 4.56 | 5.78 |
| | (19.33) | (12.04) | (20.32) | (32.91) |
| $W_7$-Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS. | 3.53 | 3.23 | 4.07 | 5.08 |
| | (12.00) | (9.96) | (16.09) | (25.36) |
| $W_8$-Mulching with waste polythene bags (ITK-practices). | 2.68 | 3.30 | 3.85 | 4.71 |
| | (6.69) | (10.41) | (14.30) | (22.08) |
| $W_9$-Weedy check. | 5.73 | 8.33 | 11.19 | 13.96 |
| | (32.36) | (69.05) | (124.77) | (194.57) |
| SEm± | 0.09 | 0.11 | 0.26 | 0.09 |
| CD (P=0.05) | 0.27 | 0.33 | 0.77 | 0.26 |

**Table 8. Weed control efficiency *kharif* of sweet corn as influenced by various weed management practices at different time interval**

| Treatments | Weed control efficiency(%) | | | |
|---|---|---|---|---|
| | 20DAS | 40DAS | 60DAS | at harvest |
| $W_1$-Hand weeding at 20 and 40 DAS. | 10.5 | 79.7 | 89.6 | 87.6 |
| $W_2$-One mechanical weeding at 20 DAS + one hand weeding at40DAS. | 15.8 | 77.8 | 88.9 | 86.9 |
| $W_3$-Intercropping with black gram(1:1). | 40.2 | 45.7 | 25.9 | 27.8 |
| $W_4$-Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding a n 20 DAS. | 88.5 | 95.8 | 95.7 | 94.1 |
| $W_5$-Locally available weed mulch (*Lantana camara*) + one hand pulling at 20 DAS. | 40.2 | 80.1 | 81.0 | 82.5 |
| $W_6$-Incorporation of neem cake 15 days before sowing, 5 tonnes $ha^{-1}$ + hand weeding at 20 DAS. | 40.3 | 82.6 | 83.7 | 83.1 |
| $W_7$-Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS | 62.9 | 85.6 | 87.1 | 87.0 |
| $W_8$-Mulching with waste polythene bags (ITK-practices). | 79.3 | 84.9 | 88.5 | 88.7 |
| $W_9$-Weedy check. | - | - | - | - |

**Table 9. Weed index, weed control efficiency and economics of *kharif* sweet corn as influenced by various weed management practice**

| Treatments | Weed index | Weed control efficiency | Total cost (Rs. $ha^{-1}$) | Gross return (Rs. $ha^{-1}$) | Net return (Rs. $ha^{-1}$) | B:C ratio |
|---|---|---|---|---|---|---|
| $W_1$- HW at 20 and 40 DAS | 3.93 | 87.6 | 64515 | 150104 | 85589 | 2.33 |
| $W_2$-1MW at 20 DAS + 1HW at 40DAS | 16.51 | 86.9 | 61995 | 130412 | 68417 | 2.10 |
| $W_3$- IC with black gram(1:1) | 34.86 | 27.8 | 59015 | 101674 | 42659 | 1.72 |
| $W_4$- SSB+RS (upto 25%)+ MPS +HW at 20 DAS | 0.00 | 94.1 | 71446 | 156406 | 84960 | 2.19 |
| $W_5$- WM+ 1HP at 20 DAS- | 23.20 | 82.5 | 61995 | 119820 | 57825 | 1.93 |
| $W_6$- ICP NC + HW at 20 DAS | 22.94 | 83.1 | 121995 | 120256 | -1739 | 0.99 |
| $W_7$- SS + 1 HW at 20 DAS | 9.04 | 87.0 | 68875 | 141982 | 73107 | 2.06 |
| $W_8$- ITK-practices | 2.36 | 88.7 | 66614 | 152562 | 85948 | 2.29 |
| $W_9$-Weedy check | 83.49 | - | 56115 | 25760 | -30355 | 0.46 |

*$W_1$- HW at 20 and 40 DAS - Hand weeding at 20 and 40 DAS.*
*$W_2$ - 1MW at 20 DAS + 1HW at 40DAS.- One mechanical weeding at 20 DAS and hand weeding at 40 DAS.*
*$W_3$- IC with black gram(1:1)- Intercropping with black gram(1:1).*
*$W_4$- SSB + RS (upto 25%) + MPS + HW at 20 DAS- Stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + hand weeding at 20 DAS.*
*$W_5$-WM+ 1HP at 20 DAS- Locally available weed mulch (Lantana camara) + one hand pulling at 20 DAS.*
*$W_6$- ICP NC + HWat 20 DAS- Incorporation of neem cake 15 days before sowing, 5 tonnes $ha^{-1}$ + hand weeding at 20 DAS.*
*$W_7$-SS + 1 HW at 20 DAS- Soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS.*
*$W_8$- (ITK-practices) - Mulching with waste polythene bags (ITK-practices*
*$W_9$- Weedy check - Weedy check*
*DAS – Days after sowi*

and periodical removal of weeds by hand weeding as per the treatment by less number of weeds and dry weight of weeds (Tables 3 & 4), which might have maintained soil fertility status and moisture content by means of less removal of plant nutrient and moisture by weeds [19-22]. These findings are in close conformity with those reported by Sinha et al. [23], Mandal *et al*., Kamble*et al*. And Desmukh *et al*. Similarly, "Mulched biomass added large quantity of nutrients and the additional nutrients over that applied through manure might have contributed to the increased yield of maize" (Sharma and Achrya., 2000 and Sharma *et al*.2010). Different weed management practices made impact on weed dry weight which directly influenced on different yield parameters and yield also.

### 3.3 Weed Parameters

The weed management treatments significantly influenced the weed dry weight (Table 3) The stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + 20 DAS hand weeding recorded significantly lower weed dry weight at 60 DAS and at harvest. The weed dry weight of the stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + 20 DAS hand weeding followed by hand weeding at 20 and 40 DAS, one mechanical weeding at 20 DAS and hand weeding at 40 DAS, waste polythene bags (ITK-practices, and soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS. A perusal of data presented in (Table 9) indicated that the minimum weed index was recorded (0.00%) in stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + 20 DAS hand weeding which was followed by (2.36%) in mulching with waste polythene bags, (3.93%) in hand weeding at 20 and 40 DAS. These might be attributed to the effective control of weeds under these treatments, which reflected in less number of weeds and ultimately lower biomass. Similar findings also Adekalu *et al*. (2008) reported that "mulched promote crop development and early harvests and increase yields". Similarly, "the plastic mulch covered the soil, prevented early weed emergence through acting as physical barrier and through solarization effect" (Stapleton, 1990; Ogunyemi *et al*; 2007) and would be due to lower weed index also close conformity with those reported by Sinha *et al*., Kolage *et al*. And Verma *et al*.

The weedy check recorded significantly the highest weed dry weight of weeds owing to uncontrolled condition favoured luxurious weed growth leading increased dry matter of weeds (Table 3&4). Similar findings also weed infestation during germination to 45 days after sowing (DAS) cause maximum reduction yield Das *et al*. (2013).

### 3.4 Economics

The data showed that weed management practices significantly affects the, gross and net return. the highest net return recorded waste polythene bags (ITK-practices) (Rs. 85948 $ha^{-1}$) which was followed with, hand weeding at 20 and 40 DAS (Rs. 85589 $ha^{-1}$), stale seed bed + reduced spacing (upto 25%) + mulching with paddy straw + 20 DAS hand weeding (Rs. 84960 $ha^{-1}$), and soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DA(Rs. 73107 $ha^{-1}$), The lowest net return was found in Rs. -30355 $ha^{-1}$ accrued under treatment weedy check. The highest B:C ratio value (2.33) was calculated in hand weeding at 20 and 40m DAS which was followed by mulching with waste polythene bags(2.29), stale seed bed + reduced spacing (up to 25%) + mulching with paddy straw + hand weeding at 20 DAS(2.19) and soil solarization with 25µ polythene mulch during summer + one hand weeding at 20 DAS(2.06), the higher benefit under these treatments might be due to increased monetary returns with comparatively lower cost. These findings are close vicinity with those reported by Malviya and Singh, Rao et al. [24] Sunitha et al. [25].

## 5. CONCLUSION

Based on the findings of the field study that has been presented, it can be said that among the different weed management practices the significantly higher yield attributes, green cob and stover yield were recorded under the stale seed bed + reduced spacing (up to 25%) + mulching with paddy straw + hand weeding at 20. In terms of weed management measures, the stale seed bed + reduced spacing (up to 25%) + mulching with paddy straw + hand-weeding at 20 DAS treatment had the highest weed control efficiency and the lowest weed index. The yield was positively related to percent reduction weed dry weight and weed control efficiency. Similarly, Sanodiya et al. [24] stated that the maximum seed yield and stover yield were recorded under

2 hand weeding at 20 and 40 DAS followed by atarzine 1.0 kg $ha^{-1}$ + hand weeding at 30 DAS than the other treatment. The highest net return was obtained under mulching with waste polythene bags mulch (ITK-practices) and the highest B:C ratio was calculated under hand weeding at 20 and 40 DAS. The highest gross return was incurred in stale seed bed + reduced spacing (up to 25%) + mulching with paddy straw + hand weeding at 20 DAS. Similarly, Sharma and Gautam (2010) at the experimental site in Uttrakhand, reported maximum net returns (Rs. 18155 $ha^{-1}$) and Benefit: Cost ration (1.62) with two hand weeding as compared to rest of the weed control treatments. In the similar fashion, Rao et al. [25] stated that hand weeding twice at 15 and 30 DAS recorded the higher gross return (68445 $ha^{-1}$), net return (50945 $ha^{-1}$) and B: C ratio (2.9) in maize.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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