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Effect of date of sowing and weed management techniques on density, dry weight, control efficiency of weed and yield of blackgram (*Vigna mungo* L.)

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Abstract
A field experiment was conducted during *kharif* season at 2016 on effect of date of sowing and weed management techniques on density, dry weight, control efficiency of weed and yield of blackgram (*Vigna mungo* L.). The treatment comprises three date of sowing (S_1- 15th July, S_2- 25 July and S_3- 05th August) and four weed management techniques (W_1- Control plot, W_2- mechanical weeding at 15 and 30 DAS and removal of weeds within row by hand, W_3- Pendimethalin @ 0.75 liter a. i. ha^{-1} at 0-2 DAS + mechanical weeding at 30 DAS W_4- Pendimethalin @ 0.75 liter a. i. ha^{-1} at pre-emergence + sodium acifluorfen (16.5%) + clodinafop- propagyl (8%) EC @ 0.245 liter a. i. ha^{-1} at 20-25 DAS) respectively laid out in split plot design with three replications (Main plot consists – date of sowing and sub plot – weed management techniques). The result reveled that treatment combination of first date of sowing (S_1) with application of two mechanical weeding (W_2) at 15 and 30 DAS was found most effective for reducing weed population or densities and dry weight of weeds (*viz.* monocot, dicot and sedges weeds), higher weed control efficiency (W_2) treatment and maximumweed index (W_1) are followed by date of sowing 15th July with application of pendimethalin @ 0.75 liter. a.i. ha^{-1} at 0-2 DAS + mechanical weeding at 30 DAS.

Keywords: Blackgram, date of sowing, weed management, weed densities, weed dry weight, WCE, yield attributes

Introduction
Blackgram (*Vigna mungo* L.) also known as urdbean, belong to family leguminoseae is one of the important pulse crop grown in many Asian countries including India, where the diet is mostly cereal based. Blackgram are rich source of protein (17 to 25 %) as compared to cereals (6 to 10 %) and, their ability to fix atmospheric nitrogen and improve the soil fertility status. Among the pulses, blackgram is extensively cultivated pulse crop. It has originated from Indian sub-continent (De candoll, 1986) [6]. its seed contain 55-60% carbohydrate, 22-24% protein and 1.0-1.3% of fat besides, phosphoric acid (H_3PO_4), being 5-10 times more than other pulses. blackgram, especially contains a higher percentage of methionine compared to other food legume. Its dry stalks along with the pod husk forms a nutritive fodder especially for cattle. In India, blackgarm is grown in 3.06 million ha area with total production of 1.70 million tones and productivity 5.55 qt.ha^{-1} whereas Chhattisgarh it occupies 0.10 million ha area with total production of 0.03 million tones and productivity 3.04 qt.ha^{-1}.
The weather parameters play an important role in deciding the success or failure of the crop, because they strongly influence strongly the physiological expression and genetic potential of the crop. It is well known that yield from any given crop or variety depends on the availability of certain optimum rainfall, solar radiation, temperature, soil moisture, heat units etc. during different stages of crop growth. Among different management factors, sowing time plays a key role in obtaining higher yield. Time of sowing is known to influence the yield and growth of black gram. The optimum time is mainly dependent on prevailing agro-climatic conditions of an area besides the crop grown. Planting during the optimum period, therefore, ensures better harmony between the plant and weather which ultimately results in higher crop yields (Venkateshwarulu and Sounda Rajan, 1991) [15].
Sowing date has greatest effects on the grain yield of blackgram. Delay in sowing beyond optimum date results in a progressive reduction in the potential yield of the crop.

The time of sowing is considered as one of the important productivity limiting factors that affect the plant growth and ultimately crop yield. Time of sowing determines time of flowering and it has greatly influence on dry matter accumulation, seed set and seed yield. It also affects physiological and morphological specifications of plant like vegetative and reproductive periods, harvest time, yield and quality. For maximum yield, crop must be sown at appropriate time.Sowing times has makeable effects on growth and yield of most crops in different parts of the world as delay in sowing beyond the optimum time usually results in yield reduction (Vange and Obi, 2006) [13].

The productivity of blackgram is very low in India as well as in Chhattisgarh due to various agronomic reasons, among them weed infestation is one of the major limiting factors in production, especially during rainy (*kharif*) season. Uncontrolled weeds at critical period of crop-weed competition caused a reduction of 80-90% in yield depending upon type and intensity of weed infestation. Weed species infesting blackgram vary according to the agro-ecosystem of the growing region. Most prominent weeds species observed in blackgram fields are *Panicum colona* L., *Cynodon dactylon* L., *Cyperus rotundus* L., *Digera arvensis* Forsk, *Euphorbia hirta* L., *Leucas aspera* Spreng., *Phyllanthus niruri* L., *Indigo floraglandulosa* L., *Phyllan thusniruri* L.

Materials and Methods

The experiment was conducted at farm of RMD College of Agriculture and Research Station, Ambikapur (C.G.) during kharif season 2016, which is located at latitude of $23^0 8'$ N, longitude of $83^0 15'$E and an altitude of 623 m mean sea level. The treatment consist of three date of sowing (15th July 2016, 25th July 2016 and 5th August 2016) as main plot and four weed management techniques (W_1:Control (weedy check),W_2:Mechanical weeding at 15 and 30 DAS and removal of weeds within rows by hand, W_3:Pendimethalin @ 0.75 lit. a. i. ha^{-1} at 0-2 DAS + Mechanical weeding at 30 DAS,W_4:Pendimethalin @ 0.75 lit. a. i. ha^{-1} at pre-emergence + Sodium acifluorfen (16.5%) + clodinafop - propargyl (8 %) EC @ 0.245 lit. a. i. ha^{-1} at 20- 25 DAS) as sub plots which were laid out in split plot design. Indira urd-1 variety was sown in 30cm X 10cm (row to row and plant to plant). The observations on weed growth like weed densities and weed dry weight were recorded at 30, 45, 60 DAS and at harvest. Data on weed count and weed dry weight showed high variation. To make the analysis of variance more valid the data on weed count and weed dry weight was subjected to square root transformation by using formula $\sqrt{x} + 0.5$. Critical difference for the significant source of variation was calculated at five per cent level of significance. Treatment differences those were not significant were denoted by NS.

Weed observation

Total and category wise weed density (No. m^{-2})

The density of different weed species was studied at 30, 45, 60 DAS and at harvest. The weed study in each plot was made using a quadrate of 100 cm× 100 cm (1 m^2). Quadrate was thrown randomly three times in each plots and weed densities are were recorded accordingly. Counting of weed was done according to species and total population of weeds was also worked out. The data were calculated for m^{-2} for statistical analysis. Weed density was subjected to square root transformation on *i. e.* $\sqrt{X + 0.5}$.

Total and category wise dry weight of weeds (g m^{-2})

Dry weight of weeds are recorded at 30, 45, 60 DAS and at harvest in blackgram. Weeds present in quadrate in uprooted carefully along with roots. The roots of the sample were cut and only aerial parts were cleaned, sundried and finally oven-dried at 60 ^{0}C at 48 hours. After complete oven drying, the dry weight was recorded species wise and as well as total dry weight of weeds for different treatments. Weed dry weight was subjected to square root transformation on *i. e.* $\sqrt{X + 0.5}$.

Weed control efficiency (%)

Weed control efficiency was calculated at 30, 45, 60 DAS and at harvest on dry weight basis by adopting the formula given by Mani *et al.* (1973) [7].

$$\text{WCE (\%)} = \frac{\text{Dry matter of weeds in weedy check} - \text{Dry matter of weeds in treated plot}}{\text{Dry matter of weeds in weedy check}} \times 100$$

Weed index (%)

Weed index is reduction in yield due to weed infestation. It is calculated by using the formula

$$\text{WI (\%)} = \frac{X - Y}{X} \text{x}100$$

Where,

X- Yield of minimum weed competition (mechanical weeding) plot

Y-Yield of treated plot

Result & discussion

Weed flora associated with blackgram crop

The predominant weed species recorded in the experimental field were *Cyperus rotundus, Alternanthra sessilis, Echinochloa colona,Parthenium hystrophorus, Commelina benghalensis, Cynodon dactylon, Celosia argentia and* in the above mentioned weed flora, *Cyperus spp., Commelina benghalensis* and *Alternanthra sessilis* was the most predominant weed of the total weed flora at 30, 45 and 60 DAS and at harvest.

Effect of date of sowing and weed management practices on weed density (No. m^{-2})

Different date of sowing and weed management practices had remarkable effect on lowering the weed density, throughout the period of experimentation. The category wise weed and total density was recorded at 30, 45, 60 DAS and at harvest under different treatment and it was observed infestation of weeds was gradually increased at different times of interval in all treatments.

The data showed in table-1 on density of categories observed at 30, 45, 60 DAS and at harvest and reported that among different date of sowing, significantly highest weed population (monocot, dicot and sedges) was observed under sowing on July 15th compared to July 25th and August 5th. Minimum weed density was observed under August 5th.There was significant variation in density of total weeds due to different date of sowing. The highest density of total weeds was observed significantly with July 15th and it was at par with sowing on July 25 at 30, 45DAS and at harvest respectively. The lower density of total weeds was noted under sowing on August 5. However maximum density of total weeds might be due to the more congenial environmental available for growth and development of weeds.

Weed control treatment brought about variation in the count of categories weedsat all the stages. The number of weed population recorded slightly lower at 45 DAS and at harvest compared to 30 DAS. Weed population was found Significantly lower under mechanical weeding at 15 and 30 DAS however, removal of weeds within rows by hand, which was at par with pendimethalin @ 0.75 l. a. i. ha^{-1} at 0-2 DAS + mechanical weeding at 30 DAS. Maximum weed population was observedunder weedy check plot over all observation. This result was similar to statement of Singh *et al.* (2011) [10]. who reported two hand weeding 25 and 40 DAS recorded lower weed density which was closely followed by pendimethalin 0.45 kg ha^{-1} + hand weeding 25 DAS and pendimethalin 0.75 kg ha^{-1}similar result have also been reported by Vaishay *et al*, (2003).

Weed management practices also showed significant variation on density of total weeds. It was noted that application of mechanical weeding applied at 15 and 30 DAS and removal of weeds within rows by hand resulted in the lowest density of total weeds during all the stages of observation and it was at par to pendimethalin @ 0.75 l. a.i. ha^{-1} at 0-2 DAS + mechanical weeding at 30 DAS except at 30 DAS followed by Pendimethalin @ 0.75 l. a. i. ha^{-1} at pre-emergence + sodium acifluorfen (16.5%) + clodinafop-propargyl (8 %) EC @ 0.245 l. a. i. ha^{-1} at 20- 25 DAS. Maximum density of total weed was found under weedy check plot among all investigation period.

Hand weeding was found very effective to control all type of weeds, during all the stages of crop growth which might be due to its effectiveness. Pre-emergence application of pendimethalin @ 1.5 kg ha^{-1} was effective to control weeds during early stages of crop. The weed density was significantly highest in weedy check which was due to absence of suitable weeds management practices. Choudhary *et al.* (2012) [5]. reported that two hands weeding at 15 and 24 DAS was found effective for weed control followed by pendimethalin @1.5 l. ha^{-1} and one hand weeding at 25 DAS.

Effect of date of sowing and weed management practices on weed dry matter accumulation (g m^{-2})

The dry matter productions of categories wiseat different time interval influenced by various treatments are presented in Table 2. There was significantly variation in dry matter production due to different treatments of date of sowing and significantly highest dry matter production was observed with July 15th. However, it was found at par with sowing on July 25 at 30, 45 DAS and at harvest. The lowest dry matter was recorded under sowing on August 5. Higher dry matter production might be due to the more congenial environmental available for growth and development of weeds.

Weed management practices also showed significant variation on total dry matter production of weeds. Significantly lower dry weight was observed that application of mechanical weeding at 15 and 30 DAS and removal of weeds within rows by hand during all the stages of observation, but it was at par with pendimethalin @ 0.75 l. a.i. ha^{-1} at 0-2 DAS + mechanical weeding at 30 DAS except 30 DAS. Vaishay *et al.* (2003) was also reported the similar result.

There was significant variation in dry matter production of total weeds due to different date of sowing. Significantly highest dry matter production of total weedswas observed with the sowing date on July 15th and the lowest dry matter of total weedswas found with the sowing on August 5. Higher dry matter production might be due to the more congenial environmental available for growth and development of weeds.

Weed management practices also showed significant variation on dry matter production of total weeds. It was observed that application of mechanical weeding at 15 and 30 DAS and removal of weeds within rows by hand resulted in the lowest weed dry matter production during all the stages of observation, but it was at par with pendimethalin @ 0.75 l. a.i. ha^{-1} at 0-2 DAS + mechanical weeding at 30 DAS except at 30 DAS. Aggarwal *et al.* (2014) also reported that the minimum dry weight of weeds was recorded under 2 hand weeding (20 and 40 DAS), which was significantly lower than all other weed control treatments.

Dry matter production of total weeds was significantly highest in weedy check might be due to absence of suitable weed management practices, which leads to accumulation of more dry matter in weeds up to harvest. These results are in conformity to the findings of Banjara *et al.* (1999) [2]. and Raman *et al*. (2005) [8].

The data revealed that all weeds were controlled effectively by hand weeding during at all stages of crop growth. All type of herbicides applied in this trial were found effective to control different types of weeds might be because of its nature of selectivity as well as appropriate dose of application. The variations in dry matter production of weeds at different periods was observed due to effect of different weed management practices which influenced weed density and ultimately dry matter production of weeds. Similar result was observed by Begum and Rao (2006) [3]. who reported that hand weeding at 15 and 30 DAS was found effective to reduce the dry weight of all weeds.

Weed index (%)

Weed index indicate the reduction in yield due to crop-weed competition as compared to mechanical weeding twice (15 and 30 DAS). The data on weed control efficiency as influenced by different treatments are presented in Table 3.

It is quite clear from the data that maximum weed index was found under weedy check (38.14%) due to the fact that there was minimum seed yield, whereas minimum weed index was found in Pendimethalin @ 0.75 l. a. i. ha^{-1} at 0-2 DAS + mechanical weeding at 30 DAS (10.47%). This might be due to effective weed control during critical stage of crop growth periods which gave congenial environment for better growth and development of crop plant which in turn resulted in optimum grain yield. This is in agreement with findings of Banjara *et al.* (1999) [2]. Yadav and Shrivastava (1998) [16]. and Yadav *et al.* (1997) [17]. The maximum weed index under weedy check was due to the fact that there was minimum seed yield under weedy check because of severe crop-weed competition during critical period of crop growth.

Weed control efficiency (%)

The highest weed control efficiency (Table 3) at harvest was witnessed under Mechanical weeding twice at 15 and 30 DAS followed by Pendimethalin @ 0.75 l. a. i. ha^{-1} at 0-2 DAS + mechanical weeding at 30 DAS. This is due to less dry matter production and density of weeds which resulted by successfully checking the weed growth in the above treatments. The minimum was found under Pendimethalin @ 0.75 l. a. i. ha^{-1} at pre-emergence + sodium acifluorfen (16.5%) + clodinafop- propargyl (8 %) EC @ 0.245 l. a. i. ha^{-1} at 20- 25 DAS. Similar results were also reported by Sankaran and Selvamani (1989) [9]. Vega *et al*. (2000) [14]. and Raman and Krishnamoorthy (2005) [8].

Effect on yield

The result on seed yield of blackgram as influence by date of sowing and different weed management practices and data are presented in Table 3. Significantly highest seed yield (10.68 q ha^{-1}) of blackgram was recorded with the crop sowing on July 15th followed by sowing on July 25th (8.93q ha^{-1}) and the lowest seed yield (6.37 q ha^{-1}) was noted with sowing on August 5th. All the sowing dates differed significantly from each other. The seed yield is the ultimate outcome of growth and performance of yield attributing characters of a crop. The superiority of growth characters *viz*. branches, dry matter accumulation, number of nodules and weight and increased number of yield attributes such as pods plant^{-1} and seeds pod^{-1} as discussed earlier may be the possible reasons for the production of higher yield under July 15 sowing. The results are in accordance with the findings of Bhaskar (2005) [4]. and Singh *et al*., (2007) [11].

Among the weed management practices, significantly highest seed yield (10.25 q ha^{-1}) was observed under mechanical weeding at 15 and 30 DAS and removal of weeds within rows by hand followed by pendimethalin @ 0.75 l. a. i. ha^{-1} at 0-2 DAS + mechanical weeding at 30 DAS (9.27 q ha^{-1}) and pendimethalin @ 0.75 l. a. i. ha^{-1} at pre-emergence + sodium acifluorfen (16.5%) + clodinafop- propargyl (8 %) EC @ 0.245 l. a. i. ha-1 at 20- 25 DAS). While, the lowest seed yield was noted under weedy check (6.23 q ha^{-1}). Higher seed yield was observed in mechanical weeding at 15 and 30 DAS and removal of weeds within rows by hand due to more number of pods plant^{-1}, seeds pod^{-1} and number of seeds plant^{-1}. Raman and Krishnamoorthy (2005) [8]. also reported that twice hand weeding recorded the highest number of pods plant^{-1} ultimately resulting in the highest seed yield (858 kg ha^{-1}).

Table 1: Category wise weed densities (number m^{-2}) at 30, 45, 60 DAS and at harvest in blackgram influenced by different date of sowing and weed management practices

Treatment	Monocot				Dicot				Sedge				Total weed densities			
	30DAS	45 DAS	60 DAS	At harvest	30DAS	45 DAS	60 DAS	At harvest	30DAS	45 DAS	60 DAS	At harvest	30DAS	45 DAS	60 DAS	At harvest
Date of sowing																
S_1: 15 July, 2016	6.51 (44.42)	5.84 (40.67)	6.87 (52.75)	5.32 (31.67)	8.28 (72.00)	7.17 (62.33)	8.10 (74.58)	6.64 (52.33)	7.84 (62.33)	6.17 (44.5)	6.51 (49.25)	5.66 (35.75)	13.12 (178.75)	11.09 (147.50)	12.43 (176.58)	10.18 (119.75)
S_2:25 July, 2016	5.49 (31.50)	5.18 (31.58)	6.22 (41.75)	4.56 (23.42)	7.28 (56.83)	6.40 (51.25)	7.36 (64.33)	5.89 (42.17)	7.27 (53.08)	5.65 (36.67)	5.79 (38.5)	5.18 (29.83)	11.67 (141.42)	9.95 (119.50)	11.22 (144.58)	9.04 (95.42)
S_3: 05 Aug., 2016	4.96 (25.25)	5.00 (28.67)	5.92 (38.00)	4.34 (20.25)	6.77 (49.00)	6.04 (45.50)	6.77 (54.25)	5.41 (35.58)	6.93 (49.00)	5.09 (27.67)	5.08 (27.75)	4.70 (24.5)	10.86 (123.25)	9.34 (101.83)	10.30 (120.00)	8.34 (80.33)
SEm±	1.11	0.54	0.84	0.98	0.66	1.08	1.07	0.38	1.22	1.55	1.79	1.07	1.05	1.82	2.99	1.03
CD(P=0.05)	4.38	2.11	3.28	3.85	2.59	4.26	4.19	1.48	4.79	6.09	7.05	4.19	4.11	7.17	11.75	4.04
Weed management																
W_1	7.69 (59.89)	8.79 (77.33)	9.64 (93.22)	7.27 (53.00)	10.57 (111.67)	11.69 (136.56)	12.36 (152.78)	10.62 (112.89)	8.67 (74.89)	9.16 (85.44)	9.48 (91.78)	8.23 (67.89)	15.67 (246.44)	17.25 (299.33)	18.32 (337.78)	15.26 (233.78)
W_2	4.14 (17.00)	3.03 (8.78)	4.49 (19.78)	2.94 (8.22)	5.12 (26.00)	3.64 (12.89)	4.63 (21.33)	3.70 (13.44)	5.78 (33.11)	3.84 (14.33)	4.07 (16.22)	3.46 (11.56)	8.72 (76.11)	6.02 (36.00)	7.58 (57.33)	5.78 (33.22)
W_3	5.07 (25.56)	3.43 (11.33)	4.74 (22.11)	3.56 (12.33)	7.18 (51.78)	3.88 (14.78)	4.92 (24.00)	3.94 (15.11)	7.28 (53.11)	4.18 (17.00)	4.32 (18.33)	3.97 (15.33)	11.38 (130.44)	6.59 (43.11)	8.03 (64.44)	6.56 (42.78)
W_4	5.72 (32.44)	6.12 (37.11)	6.47 (41.56)	5.21 (26.89)	6.91 (47.67)	6.93 (47.89)	7.72 (59.44)	5.66 (32.00)	7.65 (58.11)	5.36 (28.33)	5.29 (27.67)	5.06 (25.33)	11.75 (138.22)	10.65 (113.33)	11.34 (128.67)	19.16 (84.22)
SEm±	0.69	0.90	1.15	0.67	1.30	1.25	1.23	1.04	1.98	2.46	2.58	1.94	2.10	2.09	3.21	2.76
CD(P=0.05)	2.05	2.67	3.42	1.99	3.85	3.72	3.66	3.10	5.88	7.32	7.67	5.75	6.24	6.22	9.54	8.19

Table 2: Category wise weed dry weight (g m^{-2}) at 30, 45, 60 DAS and at harvest in blackgram influenced by different date of sowing and weed management practices

Treatment	Monocot				Dicot				Sedge				Total dry matter of weeds			
	30DAS	45 DAS	60 DAS	At harvest	30DAS	45 DAS	60 DAS	At harvest	30DAS	45 DAS	60 DAS	At harvest	30DAS	45 DAS	60 DAS	At harvest
Date of sowing																
S_1: 15 July, 2016	4.43 (22.33)	4.03 (24.99)	4.86 (33.18)	3.59 (17.92)	5.51 (35.86)	4.90 (40.84)	5.86 (53.54)	4.92 (40.03)	6.36 (44.67)	4.69 (37.44)	5.24 (41.63)	4.31 (26.82)	9.46 (102.86)	7.80 (103.27)	9.18 (128.35)	7.38 (84.77)
S_2:25 July, 2016	3.56 (14.41)	3.28 (15.62)	3.99 (21.27)	2.89 (11.36)	4.69 (26.75)	4.05 (29.48)	5.02 (41.57)	4.01 (26.34)	5.33 (30.92)	3.87 (24.49)	4.39 (28.98)	3.72 (19.58)	7.90 (72.08)	6.38 (69.59)	7.70 (91.82)	6.08 (57.28)
S_3: 05 Aug., 2016	2.87 (9.32)	2.74 (11.32)	3.54 (16.80)	2.49 (7.70)	4.17 (21.60)	3.67 (24.07)	4.33 (30.19)	3.54 (20.44)	4.71 (26.67)	3.15 (15.00)	3.63 (18.35)	3.11 (13.69)	6.84 (57.58)	5.42 (50.40)	6.58 (65.34)	5.21 (41.84)
SEm±	0.29	0.28	0.66	0.25	0.93	1.37	0.89	0.74	2.55	1.84	2.36	0.77	3.11	1.78	3.46	1.25
CD(P=0.05)	1.15	1.09	2.58	0.96	3.65	5.39	3.51	2.92	10.02	7.22	9.27	3.03	12.24	6.99	13.59	4.93
Weed management																
W_1	5.94 (35.87)	7.35 (54.91)	8.45 (72.62)	6.10 (37.94)	8.40 (70.48)	10.46 (110.17)	11.82 (141.07)	9.98 (100.97)	8.54 (73.53)	9.17 (87.27)	9.71 (97.03)	7.90 (63.04)	13.35 (179.89)	15.73 (252.35)	17.47 (310.71)	14.08 (201.94)
W_2	1.75 (2.77)	1.20 (0.97)	2.04 (3.74)	1.35 (1.37)	2.00 (3.62)	1.31 (1.26)	2.01 (3.65)	1.66 (2.32)	2.99 (9.14)	1.35 (1.41)	2.04 (3.76)	1.64 (2.23)	3.88 (15.54)	1.99 (3.64)	3.38 (11.15)	2.51 (5.92)
W_3	3.14 (9.66)	1.40 (1.52)	2.26 (4.72)	1.69 (2.39)	4.37 (19.10)	1.50 (1.79)	2.22 (4.50)	1.90 (3.14)	4.99 (25.43)	1.61 (2.15)	2.31 (4.99)	1.89 (3.10)	7.28 (54.20)	2.41 (5.45)	3.79 (14.21)	3.01 (8.62)
W_4	3.65 (13.10)	3.46 (11.85)	3.77 (13.92)	2.81 (7.62)	4.39 (19.06)	3.56 (12.64)	4.23 (17.83)	3.09 (9.33)	5.34 (28.24)	3.49 (11.75)	3.63 (12.85)	3.41 (11.76)	7.77 (60.41)	6.00 (36.24)	6.65 (44.60)	5.30 (28.70)
SEm±	0.55	0.51	0.97	0.32	0.80	1.24	1.41	0.98	2.16	2.06	3.05	1.30	3.04	2.01	4.12	2.25
CD(P=0.05)	1.62	1.51	2.88	0.94	2.36	3.68	4.17	2.90	6.43	6.12	9.06	3.86	9.04	5.98	12.22	6.67

Table 3: Weed control efficiency (WCE %), Weed index (WI %) at different growth stages of the crop and Seed yield, Stover yieldas influenced by different date of sowing and weed management practices

Treatment	WCE (%)				Weed index (%)	Seed yield
Date of sowing	30 DAS	45 DAS	60 DAS	At Harvest		
S_1: 15 July, 2016	39.09	59.47	56.85	57.34	-	10.68
S_2:25 July, 2016	40.20	59.74	57.05	58.41	-	8.93
S_3: 05 Aug., 2016	41.03	57.03	55.03	57.79	-	6.37
SEm±	0.98	0.59	0.78	1.28	-	0.33
CD(P=0.05)	3.85	2.30	3.05	5.02	-	1.31
Weed management						
W_1	0	0	0	0	38.14	6.23
W_2	69.22	87.87	82.97	85.84	0	10.25
W_3	47.50	85.41	80.79	81.55	10.47	9.27
W_4	43.70	61.72	61.49	63.99	13.83	8.89
SEm±	0.65	0.55	0.48	0.73	-	0.33
CD(P=0.05)	1.93	1.64	1.42	2.17	-	0.97

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