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Effect of sowing dates and varieties on growth and selected features of Horsegram [*Macrotyloma uniflorum* (Lam.) Verdc.] in Chhattisgarh plains under protective irrigation

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Abstract
An field experiment was conducted during post *kharif* season 2018 at Instructional Farm, BTC College of Agriculture and Research Station, Bilaspur, IGKV, Raipur (C.G.). The experiment was laid in split plot design with two factors namely three sowing dates in the main plot *i.e.* D_1 (14th September), D_2 (20th September) and D_3 (26th September) with five varieties in sub plot viz., V_1 (Bilasa Kulthi), V_2 (Indira Kulthi-1), V_3 (Chhattisgarh Kulthi-2), V_4 (Chhattisgarh Kulthi-3) and V_5 (BSP 17-2). The result revealed that maximum plant height, number of pods plant^{-1} (29.17), number of seeds pod^{-1} (5.72), seed yield plant^{-1} (3.93 g) and 1000 test weight (30.09 g) was recorded under D_1 (14th September) in sowing date and in case of varieties V_2 (Indira Kulthi-1) recorded maximum number of pods plant^{-1} (33.29) number of seeds pod-1 (6.16), seed yield plant^{-1} (4.56 g) and 1000 test weight (30.17 g). The seed yield (720.70 kg ha^{-1}) was recorded highest in D_1 (14th September) in sowing dates and in case of varieties V_2 (Indira Kulthi-1) is recorded maximum seed yield (697.04 kg ha^{-1}).

Keywords: Sowing date, variety, growth and yield

Introduction
Among the pulses, Horsegram [*Macrotyloma uniflorum* (Lam.) Verdc.] is an important post season *kharif* crop of the country commonly known as "Kulthi" belongs to the family fabaceae. Crop is an underutilized (Aiyer, 1990) [2] and unexplored (Reddy *et al*., 2008) [15] arid tropical food legume. Horsegram as a legume, it maintains soil fertility through biological nitrogen fixation in soil through root nodules and act as organic manure as well. It is suitable as a cover crop, soil and water conservation and an excellent drought tolerant (Bhardwaj and Yadav, 2012) [4], salinity tolerant (Reddy *et al*., 1998) [14] and heavy metal stress tolerant (Reddy *et al*., 2005) [13] contingent crop.
Horsegram water is prescribed for eliminating jaundice in Andhra Pradesh. Horsegram seed comprises 57.0 per cent carbohydrate, 22.0 per cent protein and 2.5 per cent fat (Sudha *et al*., 1995) [16]. It is also an excellent source of iron, calcium and molybdenum. In India, horsegram occupies an area of 326 (000 ha) with a production of 117 (000 tonnes) with an average national productivity of 358 kg ha^{-1} (Anonymous, 2016-17) [1]. Horsegram is important pulse crop mostly grown in Karnataka, Odisha, Chhattisgarh, Andhra Pradesh, Tamil Nadu and Maharashtra which together contributes about 89.23 per cent area and 86.10 per cent production. Higher productivity of horsegram is obtained in Bihar (980 kg ha^{-1}).
In Chhattisgarh, horsegram occupies an area of 44.80 (000 ha) with a production of 16.80 (000 tonnes) and average productivity of 375 kg ha^{-1} (Anonymous, 2016-17) [1]. Horsegram is an important pulse crop of the state and mostly grown in Sarguja, Jagdalpur, Kanker, Korba and Jashpur which together contributes about 69.74 per cent area and 76.61 per cent production. However, the productivity of horsegram is highest in Janjgir (375 kg ha^{-1}).

Materials and Methods
A field experiment was conducted at the Instructional Farm, BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh during post *kharif* season of year 2018. The field experiment was laid out in split plot design with three replications. The treatment consisted of three sowing dates in main plot *i.e.* D_1 (14th September), D_2 (20th September) and D_3 (26th

September) with five varieties in sub plot *viz.*, V_1 (Bilasa Kulthi), V_2 (Indira Kulthi-1), V_3 (Chhattisgarh Kulthi-2), V_4 (Chhattisgarh Kulthi-3) and V_5 (BSP 17-2). Horsegram was sown with a spacing of 30 cm × 07 cm distance Gross and net plot size were 6 m × 3 m and 5.72 m × 2.40 m respectively. To evaluate the treatment effect, the various morphological observations, growth analysis were recorded in the experiment at 25, 50, 75 Days after sowing and at harvest stage. The observations on yield and yield attributing characters were recorded at harvest of the test crop. Data were analyzed statistically to determine the significance of the characters studied. Statistical data were analysed by standard procedure by Gomez and Gomez (1984) [7] at the 5% level of significance.

Results and Discussion

Initial and final plant population (m^{-2})

It results the effect of various treatments *i.e.* sowing dates, varieties and their interaction on initial and final plant population were non-significant. Initial and final plant population ranges from 37.66 to 41.87 and 36.67 to 39.73 (m^{-2}), respectively.

Table 1: Show the plant population initial harvest

Treatment	Plant population (m^{-2})	
	Initial (15 DAS)	At harvest
A. Date of sowing (D)		
D_1: (14^{th} September)	40.85	39.01
D_2: (20^{th} September)	38.59	36.73
D_3: (26^{th} September)	39.65	38.04
S. Em ±	0.62	0.44
CD at 5%	NS	NS
B. Varieties (V)		
V_1: (Bilasa Kulthi)	39.64	36.95
V_2: (Indira Kulthi-1)	37.66	36.67
V_3: (Chhattisgarh Kulthi-2)	41.87	39.73
V_4: (Chhattisgarh Kulthi-3)	39.73	38.16
V_5: (BSP 17-2)	39.58	38.13
S. Em ±	0.93	0.74
CD at 5%	NS	NS
Interaction(D×V)		
S. Em ±	1.62	1.28
CD at 5%	NS	NS

Effect of sowing dates on growth parameters

The plant height recorded under D_1 (14^{th} September) at 25 (14.13 cm), 50 (33.93 cm), and 75 days after sowing (35.71 cm) as well as at harvest (32.45 cm) were significantly higher as compared to D_3 (26^{th} September) under study. However, values obtained in D_2 (20^{th} September) were at par with D_1 except at 50 days after sowing and which are also better than D_3 values. The possible reason of higher values of plant height under D_1 may be due to early sowing as compared to D_2 and D_3 which favour the growth and development of horsegram. Such types of result were also found by Nagaraju *et al*. (1995) [9] Biswas *et al*. (2002) [5] in blackgram.

Effect of varieties on growth parameters

Plant height recorded with V_1 (Bilasa Kulthi)) at 25 (13.60 cm), 50 (48.44 cm) and 75 days after sowing (51.96 cm) as well as at harvest (45.84 cm) were significantly highest as compared to other varieties. Variety V_5 (Indira Kulthi-1) was significantly better than V_3 (Chhattisgarh Kulthi-2) and V_4 (Chhattisgarh Kulthi-3) which are statistically at par with V_2 except 50 and 75 days after sowing. The possible explanation of higher values under V_1 may be due to its genetical superior characters. The finding of Prakash *et al.*, (2008) [11] is in similar pattern of the present study.

Table 2: Effect of sowing dates and varieties on Horsegram on plant height at different growth intervals

Treatment	Plant height (cm)			
	25 DAS	50 DAS	75 DAS	At harvest
A. Dates of sowing (D)				
D_1: (14^{th} September)	14.13	33.93	35.71	32.45
D_2: (20^{th} September)	13.79	26.99	34.61	31.51
D_3: (26^{th} September)	10.15	26.72	29.27	25.65
S. Em ±	0.17	1.33	1.08	0.64
CD at 5%	0.68	5.22	4.25	2.53
B. Varieties (V)				
V_1: (Bilasa Kulthi)	13.60	48.44	51.96	45.84
V_2: (Indira Kulthi-1)	13.11	25.62	34.51	31.69
V_3: (Chhattisgarh Kulthi-2)	12.33	22.80	25.49	22.27
V_4: (Chhattisgarh Kulthi-3)	12.11	23.20	26.13	23.16
V_5: (BSP 17-2)	12.29	26.00	27.89	26.39
S. Em ±	0.24	1.60	1.84	1.86
CD at 5%	0.71	4.68	5.36	5.42
Interaction(D×V)				
S. Em ±	0.42	2.78	3.18	3.21
CD at 5%	NS	NS	NS	NS

Effect of sowing dates on yield attributes

The no. of pods $plant^{-1}$ was significantly higher in D_1 (29.17 pods $plant^{-1}$) than the D_2 (26.80 pods $plant^{-1}$) and D_3 (23.19 pods $plant^{-1}$). Further, D_2 (20^{th} September) was significantly higher than D_3 (26^{th} September). The results are in conformation with the finding of Hussain, (1989) [9]. The number of seeds pod^{-1} recorded in studied crop were significantly higher in D_1 (5.72 seeds pod^{-1}) than D_2 (5.65 seeds pod^{-1}) and D_3 (5.47 seeds pod^{-1}). However, D_2 is significantly higher than D_3 and sowing date D_2 is at par with D_1. The highest seed yield $plant^{-1}$ was recorded in D_1 (3.93 g) which was significantly higher than the D_2 (3.12 g) and D_3 (2.98 g). The test weight of D_1 (30.09 g) was significantly higher as compare to D_3 (29.57 g) under study. However, values obtained in D_2 (29.87 g) were at par with D_1. These are in agreement with the results described by Naidu *et al*. (2017) [10].

Effect of varieties on yield attributes

The number of pods $plant^{-1}$ were significantly higher in V_2 (33.29 pods $plant^{-1}$) than V_1 (26.24 pods $plant^{-1}$), V_3 (21.20 pods $plant^{-1}$) and V_4 (19.53 pods $plant^{-1}$). Variety V_5 (BSP 17-2) *i.e.* 31.67 number of pods $plant^{-1}$ was statistically at par withV_2 (Indira Kulthi-1). Among the varieties, maximum no. of seeds pod^{-1} (6.16) was found with variety V_2 (Indira Kulthi-1) which was significantly better over all other varieties. It was followed by V_1 (5.84 seeds pod^{-1}), V_5 (5.56 seeds pod^{-1}), V_4 (5.28 seeds pod^{-1}) and V_3 (5.23 seeds pod^{-1}). Significantly higher grain yield $plant^{-1}$ (4.56 g) was recorded in V_2 (Indira Kulthi-1) followed by V_5 (3.53 g), V_4 (2.90 g), V_1 (2.90 g) and V_3. However, values obtained in V_5 (3.53 g) were at par with V_2. The significantly higher test weight of studied crop was recorded in V_2 (30.17 g) followed by V_1 (30.15 g), V_5 (29.79 g), V_4 (29.55 g) and V_3 (29.54 g).

Table 3: Effect of sowing dates and varieties on Horsegram on yield attributes

Treatment	Yield attributing characters			
	Number of pods plant^{-1}	Number of seeds pod^{-1}	Seed yield plant^{-1} (g)	Test weight(g)
A. Dates of sowing (D)				
D_1: (14th September)	29.17	5.72	3.93	30.09
D_2: (20th September)	26.80	5.65	3.12	29.87
D_3: (26th September)	23.19	5.47	2.98	29.57
S. Em ±	0.55	0.04	0.16	0.06
CD at 5%	2.15	0.15	0.61	0.24
B. Varieties (V)				
V_1: (Bilasa Kulthi)	26.24	5.84	2.88	30.15
V_2: (Indira Kulthi-1)	33.29	6.16	4.56	30.17
V_3: (Chhattisgarh Kulthi-2)	21.20	5.23	2.84	29.54
V_4: (Chhattisgarh Kulthi-3)	19.53	5.28	2.90	29.55
V_5: (BSP 17-2)	31.67	5.56	3.53	29.79
S. Em ±	1.56	0.04	0.37	0.10
CD at 5%	4.57	0.12	1.07	0.30
Interaction(D×V)				
S. Em ±	2.71	0.07	0.64	0.18
CD at 5%	NS	NS	NS	NS

Effect of sowing dates on yield

Sowing date D_1 (14th September) produced significantly highest seed yield (720.70 kg ha^{-1}) as compared to D_2 (567.54 kg ha^{-1}) and D_3 (525.61 kg ha^{-1}). Similarly D_2 also recorded significant higher yield as compared to D_3. Sowing date D_3 produced 525.61 kg ha^{-1} and is stood 3rd in position. Production of lower value of yield and yield attributing characters of seed by the crop may be there possible reason of reduction in yield under delayed in sowing, The results confirm the findings of Rafey *et al*. (1988) [12], Bajpai *et al.* (1990) [3] and Nagaraju *et al*. (1995) [9]. Sowing date D_1 (14th September) produced significantly highest straw yield (1106.41 kg ha^{-1}) as compared to D_2 (939.36 kg ha^{-1}) and D_3 (878.99 kg ha^{-1}). Similarly, D_2 also recorded significant higher yield compared to D_3. Sowing date D_3 produced 878.99 kg ha^{-1} and is in 3rd position. The result confirms the investigation of Rafey *et al*. (1988) [12], Bajpai *et al*. (1990) [3], Bobade *et al*. (2018) [6] and Nagaraju *et al*. (1995) [9]. D_1 (14th September) produced significantly highest biological yield (1823.78 kg ha^{-1}) as compared to D_2 (1506.87 kg ha^{-1}) and D_3 (1404.54 kg ha^{-1}). Similarly, D_2 also registered notable higher yield (1506.87 kg ha^{-1}) compared to D_3. The result confirms the investigation of Rafey *et al*. (1988) [12], Bajpai *et al.* (1990) [3] Bobde *et al*. (2018) and Nagaraju *et al*. (1995) [9]. The sowing date D_1 (14th September) observed higher harvest index (39.51%) followed by D_2 (37.66%) and D_3 (37.42%). This result confirms the finding of Bobde *et al*. (2017) in kharif green gram.

Effect of varieties on yield

The variety V_2 (Indira Kulthi-1) produced significantly highest seed yield (697.04 kg ha^{-1}) among the all other varieties. Variety V_5 (638.32 kg ha^{-1}) and V_1 (602.85 kg ha^{-1}) yielded statistically at par yield and significantly higher than V_4 (560.74 kg ha^{-1}) and V_3 (524.13 kg ha^{-1}). Variety V_4 and V_3 observed statistically similar and stood 3rd in position. The possible reason of higher yield of variety V_2 is that this variety recorded higher growth and yielding attributing parameters as compared to other varieties. Such types of varietal differences were also reported by Nagaraju *et al*. (1995) [9] and Suthar *et al*. (2017) [17] in horsegram. Variety V_2 (Indira Kulthi-1) produced significantly highest straw yield (1246.11 kg ha^{-1}) compared to all other varieties. Variety V_1 (Bilasa Kulthi) yielded (913.08 kg ha^{-1}) statistically at par with V_5 (946.97). Variety V_2 (Indira Kulthi-1) produced significantly highest biological yield (1943.15 kg ha^{-1}) of horsegram as compared to all other varieties. Variety V_1 (1515.78 kg ha^{-1}) was at par with V_5 (1585.35 kg ha^{-1}). V_3 (Chhattisgarh Kulthi-2) and V_4 (Chhattisgarh Kulthi-3) observed statistically similar and stood 3rd in position. The V_5 variety recorded peak harvest index (40.26%) and least harvest index was recorded by V_2 (35.87%).

Table 4: Effect of sowing dates and varieties on Horsegram on yield

Treatment	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest Index (%)
A. Dates of sowing (D)				
D_1: (14th September)	720.70	1106.41	1823.78	39.51
D_2: (20th September)	567.54	939.36	1506.87	37.66
D_3: (26th September)	525.61	878.99	1404.54	37.42
S. Em ±	25.76	41.88	35.69	-
CD at 5%	101.13	164.43	140.12	-
B. Varieties (V)				
V_1: (Bilasa Kulthi)	602.85	913.08	1515.78	39.77
V_2: (Indira Kulthi-1)	697.04	1246.11	1943.15	35.87
V_3: (Chhattisgarh Kulthi-2)	524.13	823.86	1347.99	38.88
V_4: (Chhattisgarh Kulthi-3)	560.74	944.59	1499.70	37.39
V_5: (BSP 17-2)	638.32	946.97	1585.35	40.26
S. Em ±	39.75	88.13	118.39	-
CD at 5%	116.01	257.25	345.55	-
Interaction (D×V)				
S. Em ±	68.84	152.65	205.05	-
CD at 5%	NS	NS	NS	-

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