Assessment of bio-inoculant, FYM, and chemical fertilizer on the growth attribute and yield of horsegram [*Macrotyloma uniflorum* (Lam.) Verdc.] in Chhattisgarh plain

ABSTRACT

A field experiment was carried out ~~during~~ at Barrister Thakur Chhedilal Collage of Agriculture and Research ~~station~~Station, Bilaspur, Indira Gandhi Krishi Vishwavidyalya, Raipur, Chhattisgarh during post *kharif* season 2020-21 entitled with **"Assessment of bio-inoculant, FYM, and chemical fertilizer on the growth attribute and yield of horsegram [*Macrotyloma uniflorum* (Lam.) Verdc.] in Chhattisgarh plain"** including organic and inorganic nutrients source with the recommended dose of fertilizers (RDF) 20:40:20 NPK kg ha^{-1} was layout at randomized block design (RBD) with nine treatments and three replications, taking a variety of horsegram "Bilasa Kulthi ". Result revealed that between the different organic and inorganic treatments T_6 (100% RDF + *Rhizobium culture* + PSB) result indicated that the highest seed yield (865.24 kg ha^{-1}) was observed, which was significantly superior over other treatments but it was at par with T_4 (100% RDF + *Rhizobium culture*) with seed yield (819.40 kg ha^{-1}) closely followed by the treatments of T_5 (75% RDF + 25% N through FYM + *Rhizobium culture*) with **(**743.24 kg ha^{-1}) and T_8 (50% RDF + 50% N through FYM + *Rhizobium* culture + PSB) with (661.50 kg ha^{-1}) , plant population (40.46 plants m^2) and plant height is (75.11) cm of horsegram. The higher growth ~~attributes~~attribute characters under the T_6 ~~has~~have been affiliated with a significantly superior ~~is~~ number of primary branch $plant^{-1}$ (5.98) , Crop growth rate (0.081) g $plant^{-1}$ day^{-1}. Relative growth rate (0.015g g^{-1} day^{-1}) Net assimilation rate (0.029 g dm^{-2} day^{-1})

Key words: Horsegram, growth attributes, organic and inorganic inputs.

INTRODUCTION:-

Pulses play an important role in agriculture next to cereals. These are the major ~~source~~sources of dietary protein, along with minerals and vitamins. It is the second rich source of dietary protein in vegetarian ~~diet~~diets in our country and also in other developing countries. Among the pulses, horsegram is an important post-~~-~~season *kharif* crop of the country commonly known as "Kulthi" and belongs to the family ~~fabaceae~~Fabaceae. It has diploid chromosome numbers of 2n = 20 (Cook *et al*., 2005). Horsegram is grown with mixed ~~crop~~crops,. The crop duration of horsegram is~~-~~ 100 – 110 days. The average yield is about 350-800 kg ha^{-1}. It is known for its medicinal use and nutritional quality. It is consumed as a whole

seed and as sprouts in India. Horsegram is used traditionally as a medicinal crop famous for its medicinal uses because different parts of the plant are used for the treatment of asthma, bronchitis, urinary ~~disorder, lowering~~disorders, cholesterol levels and kidney stones (Ghani, 2003). In India, horsegram occupies an area of 460.40 (000 ha) with a production of 181.29 (000 tonnes) with an average national productivity of 394 kg ha^{-1} (Anonymous, 2018-19). Horsegram is an 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 of production. Higher productivity of horsegram is obtained in Bihar (1000 kg ha^{-1}). In Chhattisgarh, horsegram occupies an area of 40.15 (000 ha) with a production of 15.20 (000 tonnes) and average productivity of 379 kg ha^{-1} (Anonymous, 2018-19). Horsegram is an important pulse crop of the state and ~~mostly~~is primarily grown in Sarguja, Jagdalpur, Kanker, Korba and Jashpur which together ~~contributes~~contribute about 69.74 ~~per cent~~percent area and 76.61 per cent production. However, the productivity of horsegram is highest in Janjgir (388 kg ha^{-1})

MATERIALS AND METHODS

The present research was carried out during post-*kharif* season 2020 at Instructional Farm, BTC College of Agriculture and Research Station, Bilaspur (C.G.), which was situated in dry, moist, sub-humid region at an altitude of 292 m above mean sea level on 22.09˚N latitude and 82.12˚E longitude. The soil of the experimental site was sandy-clay in texture. The Horsegram (var. Bilasa kulthi) was grown and treatments were replicated three times in RBD. The experiment consists of nine treatments *viz.*, T_1 :- 100% RDF, T_2 :- 75%RDF + 25% N through FYM, T_3 :- 50% RDF + 50% N through FYM ,T_4 :- 100% RDF + *Rhizobium* culture, T_5 :- 75% RDF + 25% N through FYM + *Rhizobium* culture, T_6 :- 100% RDF + *Rhizobium* culture + PSB T_7 : 50% RDF + 50% N through FYM + *Rhizobium* culture ,T_8 : 50% RDF + 50% N through FYM + *Rhizobium* culture + PSB T_9 :- Control plot The crop was sown on 11th September, 2020 and harvesting was done on 18th December, 2020.

The weekly maximum and minimum temperature recorded during the growing period of the crop was 28.7°C in 37th standard week of September and 8.0°C 51th standard week of December and the average maximum and minimum relative humidity was 83.05% and 43.4% on 49th and 45th standard week of (December and November) respectively, the highest sunshine hours during crop growing period was recorded 7.8 hours and the total mean weekly rainfall of 52.8mm was on 40th standard week of September respectively obtained during crop growth period from September to December~~,~~ 2020.

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The experimental area was prepared by ploughing once and harrow twice for obtain good tilth. The field was finally levelled to ensure uniform irrigation and proper drainage. Then the experimental field was laid out as per the plan of layout. The urea, single super phosphate and muriate of potash are used to supply plant nutrients i.e. nitrogen, phosphorus and potash respectively. The required quantities of all fertilizers were ~~mix~~mixed well together and there after fertilizer are applied in the furrow as a basal dose. After the preparation of the field, the seed was taken up at a seed rate of 20 kg ha^{-1}. Before sowing the healthy seeds were selected and treated with carbendazim (12 % WP) @ 2 g kg^{-1} of seed. Followed by *Rhizobium* @ 10 g and PSB culture @ 10 g kg^{-1} of seed to avoid damage caused by seed--borne disease of the crop. The furrows were opened with the help of kudali and seed were sown in the depth of 3-4 cm, ~~there after~~thereafter covering the furrow with soil and ~~maintain~~maintaining row to row spacing at 30 cm.

Harvesting was done manually when the maturity symptoms were observed. The border ~~row~~rows were firstly harvested, kept separately and treated as bulk. Then, plants from net plots were harvested. The tagged plants were removed from each plot separately. Threshing was done separately of net plot and border row by beating with sticks. Then grain were separated, winnowed, weighted and net plot yield was recorded treatment--wise.

RESULT AND DISCUSSION

Effect of INM on growth attributes and yields of horsegram :

Plant population (m^{-2}) was recorded at 25 days after the sowing and harvesting stage of the crop 25 DAS was observed that the highest number of plant population recorded in T_6 (100% RDF + *Rhizobium* culture + PSB), is (40.46 plant m^{-2}). The lowest number of plant ~~population~~populations recorded (38.53 plants m^{-2}) was recorded in treatment T_9 (Control). At harvest, it was observed that the highest number of plant ~~population~~populations recorded in T_6 (100% RDF + *Rhizobium* culture + PSB), is (38.43 plant m^{-2}). The lowest number of plant ~~population~~populations recorded (36.29 plants m^{-2}) was recorded in treatment T_9 (Control).

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At 25 DAS the data varies in plant height were found significant ~~and treatment~~. Treatment T6 (100% RDF + Rhizobium culture + PSB), earned significantly larger plant height (20.32 cm) at par with T_4 (100% RDF + Rhizobium culture), is (20.26 cm) and T_5 (75% RDF + 25% N through FYM + Rhizobium culture), is (18.85 cm) .The lowest plant height (14.45 cm) was recorded in treatment T9

(Control). ~~Almost similar~~Similar trend was also observed at 50 DAS. At harvest, the height of the plant was observed ~~declined~~to decline with respect to 75 DAS. Significantly higher plant height was recorded in T6 (100% RDF + Rhizobium culture + PSB), earned significantly larger plant height (75.11 cm) at par with T4 (100% RDF + Rhizobium culture), is (72.94 cm) and T5 (75% RDF + 25% N through FYM + Rhizobium culture), is (70.40 cm) .The lowest plant height (58.25 cm) was recorded in treatment T9 (Control).

Treatment T_6 (100% RDF + *Rhizobium* culture + PSB) recorded a significantly ~~the~~ higher number of primary branches (2.80) plant^{-1} , however, it was found at par with T4 (100% RDF + *Rhizobium* culture), is (2.69) plant^{-1} and T_5 (75% RDF + 25% N through FYM + Rhizobium culture), is (2.01) plant^{-1} . ~~Significantly~~ A significantly lower number of primary branches plant-1 (1.20) plant-1 was observed under treatment T_9 (control). The same trend followed at the time at 50 DAS and 75 DAS in the number of primary branches plant^{-1}. At in a number of primary branches plant^{-1} . Treatment T_6 (100% RDF + *Rhizobium* culture + PSB) recorded a significantly ~~the~~ higher number of primary branches (5.95) plant^{-1} . It was found at par with T4 (100% RDF + *Rhizobium* culture), is (5.75) plant^{-1} and T5 (75% RDF + 25% N through FYM + Rhizobium culture), is (5.70) plant^{-1} ~~-~~. Significantly lower number of primary branches plant-1 (3.79) plant^{-1} was observed under treatment T9 (control).

Crop growth rate (g plant^{-1} day^{-1}) The data ~~present~~presented in Table found that between 25-50 days after sowing among the treatment higher crop growth rate in T6 (100% RDF + Rhizobium culture + PSB) is (0.140 g plant^{-1} day^{-1}) and lower crop growth rate in T9 (Control) is (0.116 g plant^{-1} day^{-1}) At 50-75 days after sowing among the treatment higher crop growth rate in T6 (100% RDF + *Rhizobium* culture + PSB) is (0.130 g plant^{-1} day^{-1}) and lower crop growth rate in T9 (Control) is (0.112 g plant^{-1} day^{-1}) At 75 DAS- at harvest among the treatment higher crop growth rate in T6 (100% RDF + Rhizobium culture + PSB) is (0.081 g plant^{-1} day^{-1}) and lower crop growth rate in T9 (Control) is (0.049 g plant^{-1} day^{-1}).

Relative growth rate (g g^{-1} day^{-1}) The data ~~present~~presented in Table found that between 25-50 days after sowing among the treatment higher relative growth rate in T_6 (100% RDF + Rhizobium culture + PSB) is (0.058 g g^{-1} day^{-1}) and lower relative growth rate in T_9 (Control) is (0.038 g g^{-1} day^{-1}) At 50-75 days after sowing among the treatment higher relative growth rate in T6 (100% RDF + Rhizobium culture + PSB) is (0.028 g g^{-1} day^{-1}) and lower relative growth rate in T9 (Control) is (0.017 g g^{-1} day^{-1}) At 75 DAS- at harvest among the treatment higher relative growth rate in T6 (100% RDF + Rhizobium culture + PSB) is (0.015 g g^{-1} day^{-1}) and lower relative growth rate in T_9 (Control) is (0.006 g g^{-1} day^{-1}).

Net assimilation rate (g dm^{-2} day^{-1}) The data ~~present~~presented in Table found that between 25-50 days after sowing among the treatment higher net assimilation rate (g dm^{-2} day^{-1}) in T_6 (100% RDF + *Rhizobium* culture + PSB) is (0.075 g dm^{-2} day^{-1}) and lower net assimilation rate (g dm^{-2} day^{-1}) in T_9 (Control) is (0.058 g dm^{-2} day^{-1}) At 50-75 days after sowing among the treatment higher net assimilation rate (g dm^{-2} day^{-1}) in T_6 (100% RDF + Rhizobium culture + PSB) is (0.033 g dm^{-2} day^{-1}) and lower net assimilation rate (g dm^{-2} day^{-1}) in T_9 (Control) is (0.112 g dm^{-2} day^{-1}) At 75 DAS- at harvest among the treatment higher net assimilation rate (g dm^{-2} day^{-1}) in T6 (100% RDF + Rhizobium culture + PSB) is (0.029 g dm^{-2} day^{-1}) and lower net assimilation rate (g dm^{-2} day^{-1})in T_9 (Control) is (0.010 g $plant^{-1}$ day^{-1}).

Table 1. Effect of INM on plant population, plant height and seed yield (m^2) of horsegram~~:~~

Treatments		Plant population (m^2)		Plant height (cm)				Seed yield
		25 DAS	At harvest	25 DAS	50 DAS	75 DAS	At harvest	(kg ha^{-1})
T_1	**100% RDF**	39.00	36.60	16.26	43.90	68.71	67.09	605.01
T_2	**75%RDF + 25% N through FYM**	39.16	37.17	16.37	44.19	69.30	67.25	630.78
T_3	**50% RDF + 50% N through FYM**	38.40	36.50	15.47	42.72	67.30	65.43	571.76
T_4	**100% RDF + *Rhizobium* culture**	40.33	38.33	20.26	49.68	74.60	72.94	819.40
T_5	**75% RDF + 25% N through FYM + *Rhizobium* culture**	40.23	38.23	18.85	48.56	72.31	70.40	743.24
T_6	**100% RDF + *Rhizobium* culture + PSB**	40.46	38.43	20.32	50.28	76.43	75.11	865.24
T_7	**50% RDF + 50% N through FYM + *Rhizobium* culture**	39.60	36.42	16.31	46.29	70.13	69.0	645.45

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T_8	**50% RDF + 50% N through FYM + *Rhizobium* culture + PSB**	39.96	37.70	16.39	46.37	70.60	69.20	661.50
T_9	**Control plot**	38.53	36.29	14.45	40.76	61.58	58.25	343.34
	SEm ±	**0.51**	**0.55**	**1.22**	**1.36**	**1.86**	**1.47**	**45.37**
	CD(0.05)	**NS**	**NS**	**3.67**	**4.08**	**5.58**	**4.41**	**136.01**

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Table 2. Effect of INM Number of primary branch plant $^{-1}$ and Crop growth rate (g plant^{-1} day^{-1}) of horsegram :-

Treatments		**Number of primary branch plant $^{-1}$**				**Crop growth rate (g pla nt^{-1} day^{-1})**		
		25 DAS	**50 DAS**	**75 DAS**	**At harvest**	**25-50 DAS**	**50-75 DAS**	**75- At harvest**
T_1	**100% RDF**	1.30	3.20	4.26	4.30	0.123	0.119	0.058
T_2	**75%RDF + 25% N through FYM**	1.45	3.25	4.60	4.81	0.128	0.121	0.061
T_3	**50% RDF + 50% N through FYM**	1.22	3.02	4.19	4.27	0.120	0.116	0.055
T_4	**100% RDF + *Rhizobium* culture**	2.69	4.79	5.75	5.83	0.136	0.129	0.075
T_5	**75% RDF + 25% N through FYM + *Rhizobium* culture**	2.01	4.65	5.70	5.75	0.134	0.127	0.071
T_6	**100% RDF + *Rhizobium* culture +**	2.80	4.83	5.95	5.98	0.140	0.130	0.081

	PSB							
T_7	**50% RDF + 50% N through FYM + *Rhizobium* culture**	1.70	3.69	4.65	4.73	0.130	0.124	0.063
T_8	**50% RDF + 50% N through FYM + *Rhizobium* culture + PSB**	1.95	3.70	4.85	4.97	0.132	0.125	0.065
T_9	**Control plot**	1.20	2.20	3.79	3.85	0.116	0.112	0.049

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Table 3. Effect of INM Relative growth rate (g g^{-1} day^{-1})and Net assimilation rate (g dm^{-2} day)of horsegram :-

Treatments		**Relative growth rate (g g^{-1} day^{-1})**			**Net assimilation rate (g dm^{-2} day^{-1})**		
		25-50 DAS	**25-50 DAS**	**75- At harvest**	**25-50 DAS**	**50-75 DAS**	**75- At harvest**
T_1	**100% RDF**	0.041	0.018	0.008	0.064	0.016	0.019
T_2	**75%RDF + 25% N through FYM**	0.046	0.022	0.010	0.062	0.021	0.021
T_3	**50% RDF + 50% N through FYM**	0.044	0.021	0.007	**0.060**	0.017	0.017
T_4	**100% RDF + *Rhizobium* culture**	0.056	0.025	0.013	0.072	0.029	0.027
T_5	**75% RDF + 25% N through FYM +**	0.053	0.024	0.011	0.070	0.027	0.025

	***Rhizobium* culture**						
T_6	**100% RDF + *Rhizobium* culture + PSB**	0.058	0.028	0.015	0.075	0.033	0.029
T_7	**50% RDF + 50% N through FYM + *Rhizobium* culture**	0.048	0.020	0.010	0.065	0.023	0.014
T_8	**50% RDF + 50% N through FYM + *Rhizobium* culture + PSB**	0.051	0.022	0.011	0.069	0.025	0.022
T_9	**Control plot**	0.038	0.017	0.006	**0.058**	0.014	0.010

Conclusions~~:~~ :

It was evident from the result that growth attributes viz.," plant height, number of primary branches plant^{-1} crop growth rate , Relative growth rate (g g^{-1} day^{-1}) Net assimilation rate (g dm^{-2} day) and yield was ~~observed to be~~ significantly higher under treatment T_6 (100% RDF + Rhizobium culture + PSB), in horsegram ~~crop~~crops cultivated under Chhattisgarh plains conditions.

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