Effect of Drought Mitigation Strategies on Yield and Economics of Pigeon Pea (*Cajanus cajan*) in Odisha.

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ABSTRACT

A field experiment was conducted over three consecutive years (Kharif 2014-15 , 2015-16 and 2016-17) at the Centre for Pulses Research ,OUAT, Berhampur to evaluate the impact of various drought mitigation strategies on growth, yield attributing characters and economics of medium duration pigeon pea (var. ASHA). Altogether 10 numbers of moisture conservation technologies i.e., T1: seed hardening with CaCl2 (2%), T2: Vermicompost @ 2.5t/ha ,T3: FYM @ 5t/ha + 2% KH_2PO_4 spray at flowering + 2% KNO_3 spray at pod development stage , T4:Mulching with organic residues @ 5t/ha, T5: Pusa hydrogel @ 2.5kg/ha, T6: T1 + T5 , T7: T2 +T5, T8: T3 +T5, T9:T4+T5, T10: Control (STBF) , were taken under rainfed condition with three replications in RBD. The result revealed that T7 (Vermicompost+ Pusa hydrogel) recorded maximum grain yield (1583.7 kg/ha) which was very close with T2 ,T8 and T3 computing grain yield of 1519.3, 1507.1 & 1474.4 kg/ha respectively. Highest net return was obtained from T3 (Rs. 44742/-), followed by T8 (43689/-) and T4 (40979/-). Highest B:C ratios were recorded with T4 i:e: mulching (3.28), followed by T3 (FYM, 3.18) and T1 (seed hardening, 3.10). Pusa hydrogel, though enhanced yield over control (14.97 %) but has neither conspicuous effect nor economically viable . Use of vermicompost, though increased yield to a great extent (73.4 %), but being very costly reduced net return & B:C ratio. Seed hardening with $CaCl_2$ increased yield to a tune of 42 % and recorded high B:C ratio (3.10) due to less investment. Application of FYM with foliar sprayings of 2% KH_2PO_4 at flowering + 2% KNO_3 at pod development, increased yield to a tune of 61.47 % than that of control, recorded highest net return (Rs. 44742/- per ha.) with attractive B:C ratio (3.18) may be recommended for mitigating drought, followed by organic mulching and seed hardening with $CaCl_2$.

Key words: Drought mitigation, Pusa hydrogel, seed hardening, Vermicompost, Mulching

1. Introduction

Pigeon pea is a versatile deep rooted legume crop, well known for its drought tolerance under *Kharif* rainfed upland ecosystem (Emefiene *et. al.*, 2013) and very often affected with vagaries of monsoon. Odisha farmers prefer medium duration pigeon pea with 160-180 days duration due to their high yield potentiality. Prolonged dry spells during the critical growth stages especially during flowering to pod development stage (terminal drought), heavily reduce the yield of the crop. The national productivity (approx. 800kg/ha) lag far behind to its potential yield of 1500-3000 kg/ha. Aberrant weather condition coupled with early cessation of monsoon is one of the most important factor responsible for this gap. This situation is more intensive in light soil with low organic matter content. Moisture conservation technologies like mulching, foliar sprayings and seed treatments enhanced yield in Pigeon pea in Tamil Nadu (Selvi *et. al*.2009). Pulses are indispensible for both human and soil health. It is apparent that major breakthrough in pulse production will have to be in rainfed areas as about 93% of total area under pulses in rainfed (Sharma, 1998). Owing to its longer duration, this crop is prone to drought during its vegetative and reproductive stages. Management practices act as an important tool for drought mitigation and yield enhancement under moisture stress condition. Cultural mulch or opening shallow furrows between two rows of pigeon pea conserve soil moisture in clay loam soil of Andhra Pradesh (Reddy *et. al.* , 2009).

2. Materials & Method

A field experiment was conducted as coordinated trial under AICRP on Pigeon pea over three consecutive years (*Kharif* 2014-15, 2015-16 and 2016-17) at the Centre for Pulses Research, OUAT, Berhampur-761001 which comes under East and South Eastern Coastal Plain zone of Odisha and East coast plains & hills agro-climatic zone of India to evaluate the impact of various drought mitigation strategies on growth, yield attributing characters and economics of medium duration pigeon pea under rainfed condition. Altogether 10 numbers of moisture conservating technologies, i.e., T1- seed hardening with $CaCl_2$ (2%), T2- T2: Vermicompost @ 2.5t/ha ,T3: FYM @ 5t/ha + 2% KH_2PO_4 spray at flowering + 2% KNO_3 spray at pod development stage , T4:Mulching with organic residues @ 5t/ha, T5: Pusa hydrogel @ 2.5kg/ha, T6: Seed hardening with $CaCl_2$ (2%) + Pusa hydrogel @ 2.5kg/ha, T7: Vermicompost @ 2.5t/ha + Pusa hydrogel @ 2.5kg/ha, T8: FYM @ 5t/ha + Pusa hydrogel @ 2.5kg/ha + 2% KH_2PO_4 spray at flowering + 2% KNO_3 spray at pod development stage . T9: Pusa hydrogel @ 2.5kg/ha + Mulching with organic residues @ 5t/ha, T10: Control were taken under rainfed condition with three replications in RBD. The pigeon pea var. ASHA (ICPL 87119) was sown on mid-July at 90 X 20 cm spacing in each years . The soil was sandy loam with pH 5.8 , low Organic Carbon (0.41 %) , medium available phosphorus (21.38 kg/ha) and medium potassium (132.7 kg/ha).The crop has received 901.75mm , 692.75mm and 575.25mm rainfall (49, 48 and 56 rainy days respectively) during the cropping periods. All treatments are given equal amount of chemical fertilizers based on soil test based report. Growth, yield attributing characters, grain yield, harvest index, economics and soil moisture studies were taken up and analysed as per statistical procedures laid by Gomez and Gomez, 1984.

3. Result & Discussion

3.1 Growth and yield attributes

The pooled data of three years revealed that application of vermicompost with pusa hydrogel (T7) recorded maximum plant height (184 cm), closely followed by T8, T2, T3 & T4 (Table- 1) which is significantly superior to control (151.7 cm). Moisture conservation technologies enhance 17% growth as compared to the control (Table-1). Highest number of primary fruiting branches per plant (12.08), number of pods per plant (164.7) and number of seeds per pod (3.71) were also recorded from T7 which were at par with the respective figures obtained from T8, T2 & T3 (Table-1).This might be due to conservation of soil moisture as well as improvement in soil fertility status with Vermicompost and FYM . Foliar application of chemicals i:e: 2% KH_2PO_4 spray at flowering + 2% KNO_3 spray at pod development stage might have moisture management role during critical stages and might have contribution for number of pods per plant and number of healthy seeds per pod. However, control plot recorded the lowest figures in respect to all growth and yield attributing characters (Table-1).

3.2 Yield

The pooled data of three years depicted in table-1 revealed that application of vermicompost with pusa hydrogel (T7) recorded maximum grain yield of pigeon pea (1583.7 kg/ha), which computed 73.4 % higher than that of control plot (913.1 kg/ha). Grain yield of pigeon pea recorded with T7 (Vermicompost+ Pusa hydrogel) was very close with T2 (Vermicompost) , T8 (FYM @ 5t/ha+ 2% KH_2PO_4 at flowering +2% KNO_3 + Pusa hydrogel) and T3 (FYM @ 5t/ha+ 2% KH_2PO_4 at flowering +2% KNO_3 at pod dev.) and computing grain yield of 1519.3, 1507.1 & 1474.4 kg/ha respectively. Adoption of drought mitigation strategies on an average enhanced 48.4% higher grain yield as compared to the control (Table-1). Bhusa yield and stick yield followed almost same trend. Maximum total dry matter production was obtained with T7 (5383.4 kg/ha). It was interesting to observe that T2, T3, T7 &T8 computed same harvest index (0.29) as compared to control (0.24). Pusa hydrogel have little positive impact on drought mitigation, but the effect was conspicuous when applied with organics like FYM & vermicompost. All drought mitigation strategies have positive and significant effect on soil

moisture conservation and yield enhancement over control.

3.3 Economics

Economics of adoption of drought mitigation strategies was calculated on pooled grain yield of three years and presented in Table-2. Profit maximization is the most important factor for farmers point of view. The recommendation should be cost effective and replicable. Use of vermicompost, though increased yield to a great extent (73.4%) , but very costly and thus recorded low net return & B:C ratio (Table-2). Highest net return was obtained from T3 (Rs. 44,742/-), followed by T8 (43,689/-) and T4 (40,979/-). Highest B:C ratios were recorded with T4, mulching (3.28), followed by T3, FYM (3.18) and T1, seed hardening (3.10) probably due to less investment than vermicompost . Pusa hydrogel , though enhanced yield over control (14.97%) but not economically viable (very low net return). Seed hardening with $CaCl_2$ increased net return to a tune of 42.24% and recorded high B:C ratio (3.10) due to less investment. Application of FYM with foliar sprayings of 2% KH_2PO_4 at flowering +2% KNO_3 at pod development, increased yield to a tune of 61.47% and recorded highest increase in net return (83.33%) than that of control . The treatment (T3) also recorded attractive B: C ratio (3.18) and may be recommended for mitigating drought, followed by organic mulching and seed hardening with $CaCl_2$.

4. Conclusions

Considering high net return, economic profitability and at par productivity with vermin-compost (low net return due to high investment),T3 i:e, application of FYM @ 5.0 t/ha, with foliar sprayings of 2% KH_2PO_4 at flowering + 2% KNO_3 at pod development, may be recommended for mitigating drought, followed by organic mulching and seed hardening with $CaCl_2$.

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References

Emefiene, ME, Slaudeen AB and Yaroson AY, 2013. The use of pigeon pea (Cajanus cajon) for drought mitigation in Nigeria. International Letters of Natural Scieces, Vol 1, pp 6-16.

Gomez, KA and Gomez AA. 1984. Statistics Procedures for agricultural Research , 2nd edition, John Wiley and sons, IRRI, Manila, Philippines, 1-345.

Reddy M. Malla, Padmaja B and Rao L Jalapathi, 2009. Influence of drought management practices on growth and yield of pigeon pea. Indian J of Dryland Agric. Res. and Dev., Vol. 24, Issue 1, Page: 63-66.

Selvi RV, Srinivasan S, Ramasamy M and Mari muthu R. 2009. Agronomic management for pigeon pea under drought conditions. Legume Research , 32(2): 139-141.

Sharma, RA. 1998. Agric. Reviews 19 (4): 264-269.

Table.1 Effect of drought mitigation strategies on growth, yield attributes, yield and harvest index of pigeon pea. (Pooled data of three years, 2014-17) (FYM: Farm Yard Manure; TDMP: Total Dry Matter Production; HI: Harvest Index)

Treatments	Pl.ht. (cm)	No of branch/ plant	No of Pod/plant	No of seed/pod	Grain yield (kg/ha)	Bhusa Yield (kg/ha)	Stick yield (kg/ha)	TDMP (kg/ha)	HI
T1: Seed hardening with $CaCl_2$(2%)	174.5	10.15	132.6	3.36	1157.4	643.4	2461.3	4262.1	0.27
T2:Vermicompost@2. 5t/ha	179.7	11.19	154.2	3.58	1519.3	785.2	2899.4	5203.9	0.29
T3:FYM@ 5t/ha+ 2% KH_2PO4 at flowering +2% KNO_3at pod dev.	178.2	10.96	153.9	3.57	1474.4	771.4	2807.7	5053.5	0.29
T4:Mulchingwith organic residue @5t/ha	180.7	10.31	144.7	3.48	1332.9	706.4	2719.0	4758.3	0.28
T5:Pusa Hydrogel @2.5kg/ha	167.1	9.36	133.1	3.41	1049.8	626.4	2441.6	4117.8	0.25
T6: T1+T5	171.1	9.52	135.8	3.43	1219.1	646.1	2486.9	4352.0	0.28
T7: T2+T5	184.0	12.08	164.7	3.71	1583.7	819.4	2980.3	5383.4	0.29
T8: T3+T5	181.3	11.10	158.6	3.64	1507.1	768.8	2874.5	5150.4	0.29
T9: T4+T5	173.6	9.72	143.0	3.57	1348.3	714.6	2750.5	4813.4	0.28
T10: CONTROL	151.7	8.57	85.7	3.08	913.1	563.9	2262.7	3739.7	0.24
S.Ed.	9.15	1.09	17.35	0.09	135.4	61.74	188.6	296.3	
CD(5%)	19.23	2.29	36.47	0.19	341.1	129.78	396.43	622.82	

Table.2 Effect of drought mitigation strategies on yield and economics of pigeon pea (Avg.)

Treatment		Yield (kg/ha)	Increase over Control %	Gross return	Cost of production Rs.	Net Return	Increase over Control %	B:C Ratio
T1	**Seed hardening with $CaCl_2$**	1157.4	26.76	51213	16,500	34,713	42.24	3.10
T2	**Vermicompost**	1519.3	66.39	67229	28,500	38,729	58.69	2.36
T3	**FYM+KH_2PO_4+KNO_3**	1474.4	61.47	65242	20,500	44,742	83.33	3.18
T4	**Mulching**	1332.9	45.98	58979	18,000	40,979	67.91	3.28
T5	**Pusa hydrogel**	1049.8	14.97	46454	18,500	27,954	14.54	2.51
T6	**T1+T5**	1219.1	33.51	53943	19,000	34,943	43.18	2.84
T7	**T2+T5**	1583.7	73.44	70079	31,000	39,079	60.13	2.26
T8	**T3+T5**	1507.1	65.05	66689	23,000	43,689	79.02	2.90
T9	**T4+T5**	1348.3	47.66	59662	20,500	39,162	60.47	2.91
T10	**Control**	913.1	-------	40405	16,000	24,405	------	2.53