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Effect of Different Spacing and Weed Management Practices on Weeds, Crop Growth and Productivity of Pigeon Pea Variety Pusa Arhar-16

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ABSTRACT

Background: To study effect of various spacing and weed management practices on weed control, growth parameter, yield and yield attributes of pigeon pea variety Pusa Arhar-16, field experiments were conducted at Student's Research Farm, Khalsa College Amritsar, Punjab, India during *kharif* season of 2019-20.

Methods: The experiment was laid out in Split plot design with three replications. The treatments comprised of four different spacing *i.e.* S1 (30×10 cm), S2 (30×15 cm), S3 (40×15 cm) and S4 (50×25 cm) which were considered as main plot treatments and three weed management practices W1 (weedy check), W2 (pendimethalin @ 1.5 kg a.i. ha^{-1} at 1DAS) and W3 (rice straw mulch) as sub-plot treatments.

Result: It was found that maximum plant height (218.2 cm) and highest leaf area index (2.104) was recorded in treatment S1 (30×10 cm) whereas treatment S4 (50×25 cm) was superior in rest of growth parameters *viz.* maximum crop growth rate (0.85 gram per plant per day), number of primary branches (18.2 per plant) and number of secondary branches (13.8 per plant). Among yield and yield attributes, spacing S1 (30×10 cm) showed maximum grain yield (16.29 q ha^{-1}) and stover yield (49.29 q ha^{-1}) whereas, maximum number of pods per plant (154.6), pod length (4.83 cm), number of seeds per pod (3.90) and 100-seed weight (7.14 grams) were recorded in spacing S4 (50×25 cm). The weed management treatments showed non-significant effect on growth and yield parameters due to weed suppressing ability of the crop. which might be due to weed suppressing ability of the crop. It may be concluded that pigeon pea cultivar Pusa Arhar-16 performed better in narrower spacing of 30×10 cm due to its dwarf nature and it also showed good smothering effect on the weeds due to its smothering effect.

Key words: Pigeon pea, Pusa Arhar-16, Spacing, Weed management.

INTRODUCTION

Pigeon pea (*Cajanus cajan* L.) belongs to family Fabaceae. It is the 6th most important legume in the world. Globally it is cultivated in 5.6 m ha, the total production is 4.4 MT with an average productivity of 788 kg ha^{-1} (FAOSTAT, 2019). Out of which India is the largest producer with production of 3.3 MT from an area of 4.5 m ha under cultivation. It is grown in the states of Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Himachal Pradesh, Gujarat, Karnataka, Punjab and Haryana in north India and Andhra Pradesh and Tamil Nadu in South India. In Punjab, pigeon pea is cultivated in 8000 ha with total production of 7000 tones and average productivity of 875kg ha^{-1}.(Anonymous, 2018). Dry seeds of pigeon pea are consumed as split dal. Pigeon pea is also used as ration for milch cattle. Its straw is palatable and green leaves may be used as fodder.

Considering present scenario of Punjab, most of the farmers of state follow existing rice-wheat rotation which due to continuous adoption on large area, is resulting in adverse effect on soil fertility and lowering the water table. To overcome this problem there is need to add legumes in our cropping system. Legumes will help in maintaining fertility of soil and their water need is very low in comparison to rice and wheat. Pigeon pea is the best option to follow for diversification. Some glaring examples of cropping systems involving pigeon pea are pigeon pea-wheat, soybean+ pigeon pea-wheat, groundnut+pigeon pea-barley etc (Kaur *et al.,* 2015). It is also economically beneficial, as pigeon pea has very low input requirement and like any other pulse crop it has ability to tolerate drought and consequently perform better than any other crops in the fragile and harsh climate. Although its comparative yield is lower than a cereal crop like rice but its high MSP (minimum support price), low fertilizer cost, low irrigation requirement, less nutrient loss from soil etc. makes it better choice from economics and sustainability point of view.

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In pulse crops, spacing of sowing has big importance as it is one of the most significant agronomic factors having its effect on quantity as well as quality of the crop yield, with better quality at wider row spacing. However, wider row spacing may lead to more infestation of weeds in pigeon pea being a *kharif* season crop. (Rajesh *et al.,* 2015). Crop requires due care towards the weed control in initial period of growth to minimize the loss in productivity. Weeds cause yield reduction upto 30-80% in pigeon pea(Talnikar *et al.,* 2008) in pigeon pea. Therefore it is necessary to keep the crop weed free during early growth period. Generally, earlier varieties of pigeon pea are long duration, take long duration (170 days) to mature, resulting in delayed sowing of wheat. Moreover longer growing period entangled with severe crop-weed competition is also one of the main reasons for farmers of Punjab to not adopt pigeon pea in their cropping system.

Now with the development of short duration variety of pigeon pea *i.e*. Pusa Arhar-16, it can be cultivated in different cropping systems especially in rice-wheat and consequently its early maturity can ensure timely sowing of wheat. Pusa Arhar-16 was recently released and therefore it had to be tested with different spacings at Amritsar. Different spacings have variable influence on growth and yield of this crop. Weed population show high variability with different spacing, so different weed management practices were also need to be evaluated with different spacing.

MATERIALS AND METHODS

A field experiment was conducted at Students Research Farm, Khalsa College, Amritsar during *kharif* season of 2019-20. The soil of the experimental place was sandy loam with normal pH (7.5), medium in organic carbon (0.45%), low in available nitrogen (164 kg ha^{-1}), high in available phosphorus (28.5 kg ha^{-1}) and medium in available potassium (235 kg ha^{-1}).

The experiment consisted of twelve treatment combinations, comprising of four spacing geometries (cm) as main plots *i.e.* S1 (30×10 cm), S2 (30×15 cm), S3 (40×15 cm) and S4 (50×25 cm) and three weed management practices as sub plot treatments i.e. W1 (weedy check), W2 (pendimethalin @ 1.5 kg a.i. ha^{-1} at 1DAS) and W3 (rice straw mulch) which were laid out in Split plot design with three replications. The preparatory tillage was given before sowing by ploughing twice the field and given pre-sowing irrigation (*Rauni)*. When the field reached at the optimum moisture conditions, it was ploughed three times with tractor drawn cultivator followed by planking each time. A uniform, healthy and certified seed at the rate of 15 kg ha^{-1} was used. The seed was treated with *Rhizobium* culture in shade which were presoaked in water for 6-8 hours and sown by drill (*Pora)* method at different row spacing on 30 May, 2019. Only one post sowing irrigation was given (20 June 2019) and rest of water requirement was fulfilled by rainfall occurring during crop season. As per the spacing treatments thinning was done at 15 DAS to keep the plant to plant and row to row distance. Randomly five plants were tagged in net plot area for recording various growth characters and yield attributes. The crop was harvested manually with sickle at maturity on 20 October, 2019 and the produce was tied in bundles with tag from each plot and left in the field for complete drying. After drying, each bundle was weighed to record biological yield and expressed as q ha^{-1}. Then threshing was done manually with stick. The seed yield of each net plot was recorded separately and put in separate bags with specific tags. The stover weight was recorded after deducting grain weight from bundle weight and expressed as stover yield in q ha^{-1}. The analysis of statistical data was done by using EDA, software developed by the Department of Mathematics and Statistics, PAU, Ludhiana. Observations such as LAI, CGR, plant height, primary and secondary branches, weed dry weight and weed control efficiency were recorded at every 30 days interval till harvest.

RESULTS AND DISCUSSION

Effect on weeds

In Table 1, given data showed that at 30 and 60 DAS minimum weed dry weight was recorded in spacing S1 (30×10 cm) *i.e.* 2.29 and 7.93 respectively, which was significantly better than other spacing. This clearly revealed that weed dry weight was lesser in narrower spacing and more in wider spacing. This is because there is higher intensity of crop-weed competition in narrower spacing than in wider spacing. Crop plants try to suppress weeds better in closer spacing than in wider spacing. At 30 and 60 DAS, treatment W2 (pendimethalin @ 1.5 kg a.i. ha^{-1} at 1 DAS) was superior over all other treatments having minimum dry weight of weeds (2.32 and 7.23 g m^{-2} respectively). Similar effect of pendimethalin has been reported earlier by Singh *et al.* (2010). At 90 DAS, 120 DAS and at harvest, weed dry weight was found to be very less because after 90 DAS crop plant gained sufficient height and canopy so that weeds under the plants were suppressed and died (Fig 1). Also, the weed dry weight was found to be non-significant at 90, 120 DAS and at harvest under different weed management treatments. The interaction effect was found to be non-significant at all stages.

Probing ahead, data in Table 2 clearly showed that at 30 and 60 DAS, narrower spacing S1 (30×10 cm) has significantly highest weed control efficiency *i.e.* 62.44% and 24.40% respectively. Similar findings were recorded by George *et al* (2009). From 90 DAS till harvest variation in weed control efficiency was found non-significant with respect to different spacings. Among weed management treatments, W2 (pendimethalin @ 1.5 kg a.i. ha^{-1} at 1 DAS) was recorded significantly highest weed control efficiency *i.e.* 33.19% and 37.39% respectively. From 90 DAS till harvest weed control efficiency was found numerically too low, because of almost complete suppression of weed growth in weedy check as well, hence there were no significant differences among different weed management treatments. The interaction effect was found to be non-significant at all stages.

Growth parameters

The data embodied in Table 3, indicated that the effect of different spacing was non-significant on days taken to emergence. Almost equal days were taken by crop for emergence at different spacing. Whereas, the plant height was significantly higher in closer spacing than in wider spacing. Maximum plant height was recorded in S1 (30×10 cm) *i.e.* 218.2 cm and as the spacing decreased from S4 (50×25 cm) to S1 (30×10 cm), there was increase in plant height, which was due to closer plant to plant distance in narrower spacing. The reason behind increase in plant height at closer spacing was increased interplant competition for light, while less space available for growth of each plant. These results were found by Singh *et al.* (2010) and Sathe and Patil (2012). LAI was recorded significantly higher in S1 (30×10 cm) spacing *i.e.* 2.104 from rest of other geometries. This might be due closer spacing and denser plant population in S1. As a result LAI increased with rising plant density. Sathe and Patil (2012) also such trends. Apart from that, the highest CGR was recorded in S4 (50×25 cm) i.e. 0.85 which was followed by S3, S2 and S1 which were also significantly different with each other. This might be due to availability of more space and less competition between crop plants in wider spacing. These results are supported by the findings of Dhandyayuthapani *et al.* (2015). Also primary and secondary branches were found to be maximum in S4 (50×25 cm) *i.e.* 18.2 and 13.8 per plant

Table 1: Effect of different spacing and weed management practices on weed dry weight in pigeon pea variety Pusa Arhar-16.

Treatments	Weed dry weight (g m^{-2})				
	30 DAS	60DAS	90DAS	120DAS	At harvest
Spacing					
S1 (30×10 cm)	2.29	7.93	1.38	1.27	1.27
	(2.75)	(62.47)	(1.41)	(1.12)	(1.12)
S2 (30×15 cm)	2.46	8.27	1.39	1.28	1.27
	(5.53)	(67.92)	(1.42)	(1.13)	(1.12)
S3 (40×15 cm)	2.64	8.51	1.40	1.28	1.28
	(6.48)	(71.95)	(1.45)	(1.14)	(1.13)
S4 (50×25 cm)	2.68	8.72	1.40	1.28	1.28
	(6.68)	(75.56)	(1.46)	(1.14)	(1.13)
CD (p=0.05)	0.02	0.03	NS	NS	NS
Weed management practices					
W1 (weedy check)	2.79	9.12	1.42	1.29	1.28
	(7.32)	(82.64)	(1.52)	(1.17)	(1.14)
W2 (pendimethalin @	2.32	7.23	1.40	1.27	1.27
1.5 kg a.i. ha^{-1}) at 1 DAS	(4.89)	(51.74)	(1.43)	(1.12)	(1.12)
W3 (rice straw mulch)	2.39	8.23	1.39	1.28	1.28
	(5.24)	(67.30)	(1.44)	(1.13)	(1.13)
CD (p=0.05)	0.06	0.68	NS	NS	NS
Interaction	NS	NS	NS	NS	NS

Note: Figures in parentheses indicate original values which were transformed to square root transformation $(X+0.5)^{1/2}$

Table 2: Effect of different spacing and weed management practices on weed control efficiency (WCE) in pigeon pea variety Pusa Arhar-16.

Treatments	WCE (Weed Control Efficiency) %				
	30 DAS	60DAS	90DAS	120DAS	At harvest
Spacing					
S1 (30×10 cm)	62.44	24.40	7.23	4.27	1.75
S2 (30×15 cm)	24.45	17.81	6.57	3.41	1.05
S3 (40×15 cm)	11.47	12.93	4.60	2.56	0.87
S4 (50×25 cm)	8.74	8.56	3.94	2.54	0.52
CD (p=0.05)	2.82	3.32	NS	NS	NS
Weed management practices					
W1 (weedy check)	0.00	0.00	0.00	0.00	0.00
W2 (pendimethalin @ 1.5 kg a.i. ha^{-1}) at 1 DAS	33.19	37.39	5.92	3.84	1.58
W3 (rice straw mulch)	28.41	18.56	5.26	3.41	0.87
CD (p=0.05)	4.34	5.24	NS	NS	NS
Interaction	NS	NS	NS	NS	NS

respectively. The number of branches decreased towards narrow spacing. Thus maximum number of branches were recorded in S4 followed by S3, S2 and S1.

Among weed management practices, the data in Table 3 showed that days taken to emergence, plant height, leaf area index (LAI), crop growth rate (CGR) and number of branches (primary and secondary) were found to be non-significant. The probable reason behind showing non-significant difference could be due to lower infestation of weeds at early stage (30 DAS). At 60 DAS, when weeds growth was at their maximum, crop plants were in their grand growth period and already gained sufficient height (more than 1.2 m) and dense canopy, so weeds could not influence growth of crop plants. Moreover at 90 DAS, due to heavy canopy and considerable plant height, weeds were highly suppressed under crop plants. Particularly, crop characteristic of self-mulching (*i.e.* shedding its leaves and cover the ground surface completely) also played an important role in weed suppression at this stage. The interaction effect was found to be non-significant at all the stages.

Yield and yield attributes

The data in given Table 4 revealed that the highest grain yield (16.29 q ha^{-1}) was obtained with narrower spacing S1 (30×10 cm) which was significantly higher than wider spacing of 30×15 cm (14.13 q ha^{-1}), 40×15 cm (11.08 q ha^{-1}) and 50×25 cm (8.50 q ha^{-1}). It might be due to more number of plants per unit area in S1 than S2, S3 and S4. Likewise highest stover yield was recorded in spacing S1 (49.29 q ha^{-1}) which was significantly higher than S2 (47.95 q ha^{-1}), S3 (45.04 q ha^{-1}) and S4 (43.67 q ha^{-1}). This could be due to more number of plants and dry matter production per unit area. Similar results were found by Umesh *et al.* (2013).

However, the maximum number of pods per plant (154.6), pod length (4.83), number of seeds per pod (3.90),

Table 3: Effect of different spacing and weed management practices on various growth parameters of pigeon pea variety Pusa Arhar-16.

Treatments	Growth characters					
	Days taken to emergence	Plant height (cm)	Leaf Area Index (LAI)	CGR (g plant^{-1} day^{-1})	Primary branches (No. plant^{-1})	Secondary branches (No. plant^{-1})
Spacing						
S1 (30×10 cm)	6.5	218.2	2.104	0.78	15.6	10.9
S2 (30×15 cm)	6.5	214.1	2.028	0.80	16.3	11.8
S3 (40×15 cm)	6.8	211.3	1.948	0.83	17.5	12.5
S4 (50×25 cm)	6.7	209.5	1.897	0.85	18.2	13.8
CD (p=0.05)	NS	1.3	0.014	0.02	0.4	0.6
Weed management practices						
W1 (weedy check)	6.3	212.4	2.010	0.82	16.2	12.0
W2 (pendimethalin @ 1.5 kg a.i. ha^{-1}) at 1 DAS	6.8	214.8	1.986	0.84	16.6	12.2
W3 (rice straw mulch)	6.9	213.2	1.972	0.83	16.5	12.3
CD (p=0.05)	NS	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS

Table 4: Effect of different spacing and weed management practices on yield and yield attributes in pigeon pea variety Pusa Arhar-16.

Treatments	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})	No. of pods plant^{-1}	Pod length (cm)	No. of seeds pod^{-1}	100-seed weight (g)
Spacing						
S1 (30×10 cm)	16.29	49.29	136.2	4.25	3.15	6.52
S2 (30×15 cm)	14.13	47.95	142.4	4.47	3.33	6.70
S3 (40×15 cm)	11.08	45.04	148.2	4.52	3.65	6.92
S4 (50×25 cm)	8.50	43.67	154.6	4.83	3.90	7.14
CD (p=0.05)	1.92	1.63	3.0	0.04	0.09	0.14
Weed management practices						
W1 (weedy check)	11.50	46.10	144.2	4.50	3.47	6.80
W2 (pendimethalin @ 1.5 kg a.i. ha^{-1}) at 1 DAS	12.51	47.12	146.4	4.54	3.54	6.84
W3 (rice straw mulch)	11.92	46.72	145.3	4.52	3.51	6.83
CD (p=0.05)	NS	NS	NS	NS	NS	NS
Interaction	NS	NS	NS	NS	NS	NS

Fig 1: Almost complete suppression of weeds by the crop after 90 DAS till harvest in weedy check (self mulching characteristic of the crop is one of the major factors).

100-seed weight (7.14) were found in S4 (50×25 cm). This might be due to availability of more space and resources in wider spacing *i.e.* S4 (50×25 cm). Khan *et al.* (2010) concluded that plants that absorbed more nutrients, received more light and produced more photosynthates, resulting in more seeds per pod. Ahmad *et al.* (1997) reported that maximum 100-seed weight was found in wider spacing geometry. Whereas considering weed management treatments, it does not show any significant effect on yield and yield attributes. The interaction effect was also found to be non-significant.

CONCLUSION

Pigeon pea cultivar Pusa Arhar-16 performed better in narrower spacing of 30×10 cm due to its dwarf nature and determinate growth in terms of seed and stover yield. Weed management practices of pendimethalin as PRE or straw mulching resulted in lower weed infestation but did not significantly influence the growth characters, yield and yield attributes of the crop due to its smothering effect.

RERERENCES

Anonymous (2018). Package of practices of *kharif* crops of Punjab. Punjab Agricultural University, Ludhiana, pp 78-80.

Ahmad, R., Nazir, M.S., Saeed, M., Mahmood, T. and Jabbar, A. (1997). Effect of spatial arrangement on agronomic traits of two autumn-planted sunflower hybrids. Pakistan Journal of Agricultural Sciences. 34: 33-36.

Dhandayuthapani, U.N., Vimalendran, L. and Latha, K.R. (2015). Growth, yield and biological indices of medium duration pigeon pea influenced by intercrop and different plant population. The Bioscan: International Quarterly Journal of Life Sciences. 10(1): 303-307.

FAOSTAT (2019). link@ http://www.fao.org/faostat/en/#data/QC

George, T.P., Reberg-Horton, S.C., Dunphy, J.E. and Smith, A.N. (2009). Seeding rates effects on weed growth and yield for organic soybean production. Journal of Weed Technology. 23: 497-502

Kaur, R., Raj, R., Das, T.K., Shekhawat, K., Singh, R. and Choudhary, A.K. (2015). Weed management in pigeon pea-based cropping systems. Indian Journal of Weed Science. 47: 267-76.

Khan, E.A., Aslam, M., Ahmad, H.K., Himayatullah, Khan, M.A. and Hussain, A. (2010). Effect of row spacing and seeding rates on growth, yield and yield components of chickpea. Sarhad Journal of Agriculture. 26(2): 201-211.

Rajesh, N., Paulpandi, V.K. and Duraisingh, R. (2015). Enhancing the growth and yield of pigeon pea through growth promoters and organic mulching-A review. African Journal of Agriculture Research. 10: 1359-66.

Sathe, H.D. and Patil, D.B. (2012). Effect of planting geometry and phosphate management on growth attributes of semi-*rabi* pigeon pea. Crop Research. 44: 331-334

Singh, G., Aggarwal, N. and Ram, H. (2010). Effect of row spacing and weed management practices on weeds, growth and yield of pigeon pea. Indian Journal of Weed Science. 42 (3 and 4): 241-243.

Talnikar, A.S., Kadam, G.L., Karande, D.R. and Jogdand, P.B. (2008). Integrated weed management in pigeon pea International Journal of Agricultural Sciences. 4: 363-70.

Umesh, M.R., Shankar, M.A. and Ananda, N. (2013). Yield, nutrient uptake and economics of pigeon pea [*Cajanus cajan* (L.) Millsp.] genotypes under nutrient supply levels in dryland Alfisols of Karnataka. Indian Journal of Agronomy. 58: 554-59.