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## Livelihood security through pigeonpea based intercropping, effect on yield attributing characters and yield under rainfed condition

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#### Abstract

A field experiment was conducted during two consecutive years of *kharif* 2015-16 and 2016-17 at Soil Conservation and Water Management Farm of the C. S. Azad University of Agriculture and Technology, Kanpur to find out the effect of cropping systems and moisture conservation practices on growth, yield and economics of crops under rainfed condition. The treatments comprised of 6 cropping systems *i.e.* (i) Sole pigeonpea at 60cm by regular sowing (ii) Sole pigeonpea paired 40/80 (iii) Sole sorghum at 45 cm by regular sowing (iv) Sole urdbean at 45 cm by regular sowing (v) Pigeonpea + sorghum - paired sowing. 40/80 and (vi) Pigeonpea + urdbean - paired sowing 40/80 ; 3 moisture conservation practices *i.e.* (i) Contol (ii) Ridging and furrowing in between the crop rows after three weeks of sowing and (iii) Weeding and hoeing once at 35 DAS the crop rows were tested in Split plot design with 3 replications during the course of investigation envisages. Results obtained that the growth and yield of individual crop depressed in additive intercropping where depression was more in sorghum than blackgram. The yields of pigeonpea, sorghum and urdbean were highest in their sole stands. The yield of sole and intercropped sorghum and urdbean in terms of pigeonpea biological seed yield showed significant variation, whereas Pigeonpea + urdbean - (paired sowing 40/80) brought out significantly the highest production as compared to other cropping systems. The increase in seed yield due to Pigeonpea + urdbean paired treatment over conventional practice. The growth characters and yield attributes of three crops followed almost similar pattern of seed yield. Weeding and hoeing once at 35 DAS resulted in slightly delayed maturity of crops over control. The higher splash loss was observed under conventional practice over ridging and furrowing practice during both the years of experimentation.

**Keywords:** Livelihood security, pigeonpea, yield attributing, characters

#### 1. Introduction

The production of pigeonpea in India has shared 90 per cent to the total produce at global level. In India, it is cultivated as annual crop, but in other countries it is grown as perennial crop where pods are harvested at regular intervals. Pulses are grown under poor management practices. Among pulses, pigeonpea (*Cajanus cajan* L.) or red gram vernacularly known as Arhar, Tur, Tuwar, Thuvarya, Kandula billakandi etc. consumed mainly in the form of dal. In the Indian sub continent, it is mostly consumed as *dal*, but hot dry or green seed is consumed in Eastern Africa and mainly as cooked grain seed in Central America.

Pigeonpea is the major source of protein; Enriches soil; provide sand fuel wood; & good for arresting soil erosion. Pigeonpea is grown in 82 countries world wide either as a field crop or as backyard crop. As a regular crop, it is grown only in 19 countries on 6.2 million ha producing 4.7 million tons of grain. India has the largest area under pigeonpea (4.6 mha), followed by Myanmar (0.6 m ha), Kenya (0.13 m ha), Malawi (0.21 m ha), Uganda (0.1 mha), Tanzania (0.29 m ha), Nepal (0.03 mha) and Dominican Republic (0.02 m ha) (FAOSTAT, 2013). The gene bank at ICRISAT, Patancheru conserves 13,771 accessions

Pigeonpea (*Cajanus cajan* L.) is one of the oldest crops of our country. After chickpea, arhar is the second most important pulse crop of India. It accounts for about 11.8 percent of the total pulse area and 17 percent of total pulse production of the country. It is a rich source of protein and supplies a major share of the protein requirement of the vegetarian population of the country. Seeds of arhar are also rich in iron and iodine. Woody parts of the plant are used for fuel and other domestic purpose. Pigeonpea contributes about 15 percent in total pulses area as well as production of India.

#### Material and Method

##### Details of experiment

The experiment was carried out in split plot design with the three replications having 18

treatments combination which are allocated randomly in all plots. The details of treatments are given below.

#### A. Cropping systems - 6

1. Sole pigeonpea at 60cm by regular sowing
2. Sole pigeonpea paired 40/80
3. Sole sorghum at 45 cm by regular sowing
4. Sole urdbean at 45 cm by regular sowing
5. Pigeonpea + sorghum - paired sowing, 40/80
6. Pigeonpea + urdbean - paired sowing 40/80

#### B. Moisture conservation practices - 3

1. Control
2. Ridging and furrowing in between the crop rows after three weeks of sowing
3. Weeding and hoeing once at 35 DAS

### Results and Discussion

#### Yield Attributing Characters

##### Number of Pods /Plant

The data regarding number of pods/plant of pigeonpea as influenced by cropping systems have been epitomized in table - 1 which reveals that significant variation during both the years, pigeonpea sole paired sowing exhibited maximum number of pods/plant while minimum under pigeonpea.

Sorghum (1+1) additive series rest of the cropping systems *i.e.* pigeonpea sole regular, pigeonpea + blackgram (1+1) additive pigeonpea + sorghum (1+2) paired and pigeonpea + blackgram (1+2) paired were found under intermediate group during first & second year. The data reveal that ridging and furrowing as a moisture conservation practices brought significantly higher number of pods/plant pigeonpea over conventional practices during both the years.

Interaction between cropping systems and moisture conservation practices has been noticed during only 2016-17 pigeonpea sole observed the maximum number of pods/plant (398.0) when adopted ridging and furrowing between the crop rows as a moisture conservation practice pigeonpea + sorghum (1+1) additive series exhibited the minimum pods/plant (382.4) when it was combined conventional practice.

##### Length of POD

Various cropping system adopted in the experiment were found to vary significantly in terms of pod length (cm) of pigeonpea during both the years table - 1 pigeonpea sole paired proved to be the most viable treatment on length of pod while the lowest response was found under pigeonpea +

sorghum (1+1) additive series. Rest of the cropping systems was found under intermediate group during both the years. There was significant variation in terms of pod length of pigeonpea crop occurred in between the moisture conservation practice applied during first year. Significantly higher length of pod was recorded under ridging and furrowing practices over conventional practice during first year

##### Number of SEEDS/POD

The data table - 1 clearly indicate the sole paired sole regular and pigeonpea + blackgram (1+2) paired sowing being at par record the maximum number of seeds /pod of pigeonpea while pigeonpea + sorghum (1+2), pigeonpea + blackgram (1+1) additive the pigeonpea + sorghum (1+1) additive being at par observed the minimum number of seeds/pod during first year, but during second year sole paired and sole regular cropping being at par recorded the maximum number of seeds/pod. pigeonpea +blackgram (1+2) paired and pigeonpea + sorghum (1+1) paired sowing being at par placed under intermediate group, where as pigeonpea + sorghum (1+1) additive series exhibited the minimum number of seeds/ pod during second year of experimentation.

Number of seeds/pod of pigeonpea as affected by moisture conservation practices also exhibited marked variation, where ridging and furrowing practice proving its marked superiority over conventional practice during both the years, one two years mean basis ridging and furrowing technique brought out higher number of seeds /pod over conventional practices.

Interaction effect of various factor one number of seeds/pod of pigeonpea were found non significant during both the years.

##### 1000 seed weight

Data summarized in table - 1 indicate that 1000 –seed weight (g) of pigeonpea were marked variation due to various cropping systems applied during both the years pigeonpea sole paired sowing brought out the maximum 1000-seed weight than other cropping during both the years sole paired brought out higher 1000 seed –weight over pigeonpea + sorghum (1+1) additive series during first and second year respectively.

Interaction of (C x M) was also found significant during both the years the maximum 1000-seed weight of pigeonpea was recorded in treatment combination of pigeonpea sole paired into Ridging and furrowing and minimum under pigeonpea + sorghum (1+1) additive X conventional practice during both the year

**Table 1:** Effect of cropping systems and moisture conservation practices on number of pods/plant, pod length (cm), Number of seeds /plant and 1000 - seeds weight (gm) of pigeonpea 2015-16 and 2016-17

Treatment	Pods / plant		Pods length (cm)		Number of seeds / plant		1000 - seeds weight (gm)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
Cropping systems								
Sole pigeonpea regular	82.2	84.0	4.5	4.8	313.2	326.3	96.1	96.9
Sole pigeonpea paired	94.3	96.7	4.7	5.1	359.9	381.8	96.6	97.6
Pigeonpea + sorghum paired	79.1	81.5	4.3	4.6	291.4	311.5	95.3	96.6
Pigeonpea + urdbean paired	96.9	103.0	4.9	5.1	386.4	423.5	97.3	98.1
SE (d)	3.62	4.04	0.14	0.06	13.23	14.29	0.63	0.84
CD (P=0.05)	8.83	9.85	0.33	0.14	32.29	34.88	N. S.	N. S.
Moisture conservation practices								
Control	74.1	77.7	4.4	4.6	270.6	294.5	94.6	95.7
Ridging & Furrowing	104.7	107.1	4.8	5.1	414.6	437.4	98.0	98.9
Weeding & hoeing	85.6	89.1	4.6	4.9	328.0	350.4	96.4	97.3
SE (d)	3.16	3.54	0.11	0.05	11.52	12.54	0.56	0.73
CD (P=0.05)	6.70	7.51	0.23	0.11	24.42	26.58	N. S.	1.54

## Yield

### Biological Yield

The data pertaining to the biological yield ( $q\ ha^{-1}$ ), stover yield ( $q\ ha^{-1}$ ) and harvest index in (%) of pigeonpea have been given **table - 2** Various cropping system clearly indicate marked variation amongst them where pigeonpea + blackgram (1+2) paired sowing being at per with pigeonpea sole paired during 2015-16 but pigeonpea + blackgram (1+2) paired treatment during 2016-17 produce significantly highest biological yield of pigeonpea than other cropping system besides, pigeonpea + sorghum (1+2) paired, pigeonpea + blackgram (1+1) additive and pigeonpea sole regular proved to be place under intermediate group but pigeonpea + sorghum (1+1) additive series proved to be the lowest in respect to biological yield during both the years.

Similarly moisture conservation practices also resulted marked variation respect of biological yield of pigeonpea significantly higher biological yield was recorded under ridging and furrowing treatment than conventional practices during both the years. The interaction between cropping system and moisture conservation practices (C x M) also showed significant increase in biological yield of pigeonpea showing maximum biological yield under the treatment combination of pigeonpea + blackgram (1+2) paired planting ridging and furrowing practice followed by pigeonpea sole paired X ridging and furrowing and minimum in treatment combination of pigeonpea + sorghum (1+1) additive x conventional practices during both the years.

### Stover Yield

Various cropping system clearly indicate marked variation amongst them where pigeonpea + blackgram (1+2) paired sowing being at per with pigeonpea sole paired during 2015-16 but pigeonpea + blackgram (1+2) paired treatment during 2016-17 produce significantly highest stover yield of pigeonpea than other cropping system besides, pigeonpea + sorghum (1+2) paired, pigeonpea + blackgram (1+1) additive and pigeonpea sole regular proved to be place under intermediate group but pigeonpea + sorghum (1+1) additive series proved to be the lowest in respect to stover yield during both the years.

Similarly moisture conservation practices also resulted marked variation respect of stover yield of pigeonpea significantly higher biological yield was recorded under ridging and furrowing treatment than conventional practices during both the years. The interaction between cropping system and moisture conservation practices (C x M) also showed significant increase in stover yield of pigeonpea showing maximum stover yield under the treatment combination of pigeonpea + blackgram (1+2) paired planting ridging and furrowing practice followed by pigeonpea sole paired x ridging and furrowing and minimum in treatment combination of pigeonpea + sorghum (1+1) additive x conventional practices during both the years.

### Harvest Index

Various cropping system clearly indicate marked variation amongst them where pigeonpea + blackgram (1+2) paired sowing being at per with pigeonpea sole paired during 2015-16 but pigeonpea + blackgram (1+2) paired treatment during 2016-17 produce significantly highest harvest index of pigeonpea than other cropping system besides, pigeonpea + sorghum (1+2) paired, pigeonpea + blackgram (1+1) additive and pigeonpea sole regular proved to be place under intermediate group but pigeonpea + sorghum (1+1) additive series proved to be the lowest in respect to harvest index % during both the years.

Similarly moisture conservation practices also resulted marked variation respect of harvest index of pigeonpea significantly higher harvest index was recorded under ridging and furrowing treatment than conventional practices during both the years. The interaction between cropping system and moisture conservation practices (C x M) also showed significant increase in harvest index of pigeonpea showing maximum harvest index under the treatment combination of pigeonpea + blackgram (1+2) paired planting ridging and furrowing practice followed by pigeonpea sole paired x ridging and furrowing and minimum in treatment combination of pigeonpea + sorghum (1+1) additive x conventional practices during both the years.

**Table 2:** Effect of cropping systems and moisture conservation practices on biological yield (q/ha), stover yield (q/ha) and Harvest index in (%) of pigeonpea during 2015-16 and 2016-17

Treatment	Biological yield (q/ha)		Stover yield (q/ha)		Harvest index (%)	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
Cropping systems						
Sole pigeonpea regular	101.6	105.84	86.8	90.0	14.55	14.94
Sole pigeonpea paired	118.0	124.24	100.7	105.6	14.70	15.01
Pigeonpea + sorghum paired	111.3	135.06	95.2	97.9	14.47	14.89
Pigeonpea + urdbean paired	129.8	131.50	110.5	111.7	14.81	15.03
SE (d)	6.15	2.47	4.59	2.11	0.05	0.02
CD (P=0.05)	15.00	6.02	11.19	5.14	0.12	0.05
Moisture conservation practices						
Control	99.6	104.24	85.2	88.7	14.52	14.85
Ridging & Furrowing	135.4	136.57	115.4	115.9	14.76	15.10
Weeding & hoeing	110.4	116.67	94.3	99.2	14.62	14.95
SE (d)	4.45	4.79	3.83	4.08	0.04	0.03
CD (P=0.05)	3.43	10.16	8.12	8.65	0.08	0.07

## Conclusion

On the basis of results obtained during course of investigation, following conclusion may be inferred: The yield of sorghum and urdbean in terms of pigeonpea biological yield showed highest significant production in row crop adjustment of Pigeonpea + urdbean paired. Moreover,

stover yield and harvest index were also highest found to be the remunerative, may be recommended for adoption by cultivators of rainfed areas for boosting the crop production. Treatment of ridging and furrowing with the help of spade in between the crop rows after 3 weeks of sowing was found to be more remunerative in comparison to conventional practice

(one weeding and hoeing by *khurpi* at 35 DAS) on sandy loam soil under rainfed condition at Kanpur.

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