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RESEARCH NOTE

Performance of pigeonpea and millets in intercropping systems under rainfed conditions

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Field experiment was conducted during *kharif* season 2015-16 at Agriculture Research Station Almel, Sindagi taluk of Vijayapur district to study the performance of pigeonpea (*Cajanus cajan* L. Millsp.) based millets intercropping systems under rainfed conditions. The results indicated that sole pigeonpea ($T_{6)}$ recorded significanlty higher grain yield (1918 kg ha^{-1}) than the other intercropped pigeonpea while, the lowest grain yield (1349 kg ha^{-1}) was recorded in pigeonpea + finger millet (T2) intercorpping system. Higher pigeonpea equivalent yield (PEY) recorded in pigeonpea + foxtail millet (2752 kg ha^{-1}) and it was on par with pigeonpea + proso millet (2739 kg ha^{-1}) in 1:2 row proportions while the lowest PEY was observed in pigeonpea + pearl millet (2001 kg ha^{-1}) in 1:2 row proportion. Significantly lower soil moisture was recorded in pigeonpea + finger millet (8.99 cm, 9.40 cm, 8.98 cm)) at 30,60,90 and 120 DAS, respectively and it was on par with pigeonpea + foxtail millet (9.18 cm, 9.44 cm, 9.24 cm and 8.81 cm) at 30, 60, 90 and 120 DAS, respectively compared to other intercropping and sole cropping treatments. Singificantly higher dry matter Sccumulation in sole pigeonpea (126.24 g plant-1) compared to other intercropped pigeonpea. Singificantly higher net returns (₹ 111457ha^{-1}) and benefit cost ratio (B:C) (3.79) were recorded in pigeonpea + foxtail millet and it is on par with pigeonpea + proso millet intercropping systems in 1:2 row proportions.

Key words: Dry matter, Intercropping, Soil moisture

Pigeonpea (*Cajanus cajan* L.) is a major protein rich legume grown throughout the tropical and subtropical regions of the world between 30° N and 35° S latitudes. Major area under pigeonpea in India is lying between 14° S and 28°N latitudes, which occupies an area of about 3.90 m ha and producing 3.38 m t with an average productivity of 871 kg ha^{-1} (Anon., 2013). However, pigeonpea production alone is not economic and hence needs crop intensification for higher returns. Ram and Meena (2014) reported that intercropping of pearl millet with mung bean in 1:7 followed by 2:6 and 1:3 row ratio produced maximum pearl millet equivalent yield and net return. Inpact it is possible only when pigeonpea is planted in wider intra row spacing. The space available between the rows provides initially an opportunity for introduction of an additional crop as intercrop during mansoon which facilitates to utilize adequate moisture for pigeonpea due to utilization of seasonal rainfall. Further, by virtue of its drought tolerance, slow initial growth, perennial nature, branching habit and indeterminate phenology pigeonpea forms an component in an intercropping systems. Having accepted pigeonpea crop's suitable for intercropping system, the important point to consider the optimality would be the choice of ideal intercrop with pigeonpea. Again there is a wider range of choice amongst cereal, legumes and oilseeds expand the options. Intercropping being the main stay of dry farming areas need continuous efforts to enhance production efficiency and economic suitability of rainfed crops through intercropping. Triveni *et al.* (2017) reported that all the growth and yield contributing characters of finger millet were significantly high in solo crop compared to different intercropping systems.

The field experiment was conducted at Agricultural Research Station Almel, Sindagi taluk of Vijayapura district during *kharif* season of 2015-16 to study the performance of pigeonpea (*Cajanus cajan* L. Mill sp.) based millets intercropping systems under rainfed conditions.

The soil of the experimental site is medium to deep black in nature and the texture of the soil is clayey, belonging to the order vertisols.

The experiment was laid out in randomized complete block design (RCBD) with three replications. The experiment consisted of 11 treatments involving different intercrops and sole crops (Table 1). The crop was raised adopting recommended package of practices under rainfed conditions. The observation on growth parameters at different growth stages were recorded from randomly selected tagged five plants, yield parameters and yield was recorded at the time of harvest. The yield obtained from net plot area was converted into yield ka ha^{-1}. Similarly pigeonpea equivalent yield was calculated by taking into consideration price of crops prevailed during experimentation period.

The results revealed that total dry matter accumulation plant^{-1} was significantly higher in sole pigeonpea at all stages of crop growth compared to intercropped pigeonpea (Table 1).

Patil *et al.*(2010) noticed that intercropping of little millet and pegionpea in 5:1 row ratio produced significantly higher dry matter production, grain weight, grain yield of little millet and pigeonpea.

At harvest, significantly higher total dry weight of plant^{-1} was recorded with sole pigeonpea (126.24 g plant^{-1}) compared to pigeonpea intercropping system. Among the intercropping system, pigeonpea + pearl millet showed higher total dry matter accumulation in plant (91.56 g plant^{-1}) followed by pigeonpea + proso millet (1:2). Significantly lower total dry matter was recorded in pigeonpea + finger millet in (1:2) row proportion

Table 1. Total dry matter accumulation, pigeonpea seed yield, PEY of intercrop and economics of pigeonpea based intercropping systems as influenced by intercropping systems (1:2).

Treatments	Total dry matter accumulation at harvest	Pegionpea grain yield (kg ha^{-1})	Millets grain yield (kg ha^{-1})	PEY (kg ha^{-1})	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C
T_1 - Pigeonpea + Pearl millet(1:2)	91.56	1630	1275	2001	110070	79367	3.59
T_2 - Pigeonpea + Finger millet(1:2)	72.04	1349	2239	2367	130234	88971	3.16
T_3 - Pigeonpea + Foxtail millets(1:2)	85.39	1572	2596	2752	151398	111457	3.79
T_4 - Pigeonpea + Little millet(1:2)	80.92	1571	1796	2388	131362	90689	3.23
T_5 - Pigeonpea + Proso millet(1:2)	87.99	1621	2459	2739	150660	110374	3.74
T_6 - Sole Pigeonpea	126.24	1918	-	1918	105508	67856	2.80
T_7 - Sole Finger millet	-	-	2699	1227	67493	45275	3.04
T_8 - Sole Foxtail millet	-	-	2720	1236	68018	46568	3.17
T_9 - Sole Little millet	-	-	2392	1087	59824	37619	2.69
T_{10} - Sole Proso millet	-	-	2682	1219	67069	45113	3.05
T_{11} - Sole Pearl millet	-	-	1349	392	21598	12098	2.27
S.Em±	2.69	-	-	77	4499	4499	0.16
C.D. (p=0.05)	7.94	-		229	13273	13273	0.49

(72.04g plant^{-1}) when compared to that observed under pigeonpea + foxtail millet (1:2) and pigeonpea + little millet (1:2) and which were at par with each other. Singh *et al.*(2003) who noticed higher equivalent yield and monetary benefits of pigeonpea with sorghum, groundnut and soybean.

Finally, as a consequence of improved resource utilization pigeonpea equivalent yield (PEY) was significantly higher (2752 kg ha^{-1}) when two rows of foxtail millets were introduced in between the rows of pigeonpea Table 1. This was on par with intercropping of pigeonpea + proso millet in 1:2 row ratio (2739 kg ha^{-1}) and sole crop of pigeonpea (1918 kg ha^{-1}). These results are in agreement with the findings of Mudalagirayappa *et al.* (2011) and Sharma and Jagadev singh (2014) who recorded higher yield and net return in millets intercropping systems at Bangalore. Higher pigeonpea equivalent yield under foxtail millet and proso millet intercropping systems could be attributed to yield advantages achieved in the intercropping systems. Moreever, there was no inhibitory effect of foxtail millet and proso millet components on pigeonpea performance. Further, foxtail millet and proso millet adopted well within the rows of pigeonpea and made best use of available resources such as moisture, light above the ground and nutrients within the rhizosphere and also best market price.

In the present study, pigeonpea- based intercropping systems resulted in higher net returns and B:C (₹ 111457 ha^{-1} and 3.79) with pigeonpea + foxtail millet and it was on par with pigeonpea + proso millet (₹ 110374 ha^{-1} and 3.74) in 1:2 row proportion owing to higher output in terms of pigeonpea equivalent yield. Intercropping systems were superior to sole pigeonpea and the accrued benefits were higher by 64.25% and 62.65% with pigeonpea + foxtail millet and pigeonpea + proso millet 1:2 row proportions, respectively over sole pigeonpea. Pradhan *et al.* (2014) reported that pigeonpea + finger millet (1:4) recorded the significantly highest LER and net return. Ramachandrappa *et al.* (2016) noticed that intercropping of castor + finger millet in 1:2 row proposition recorded significantly higher castor equivalent yield (1753 kg ha^{-1}) compared to the rest of the intercropping systems and sole castor (1214kg ha^{-1}). Kujur *et al.* (2010) observed that row arrangement of pigeonpea + finger millet in 1:1 ratio produced significantly higher pigeonpea equivalent yield irrespective of duration of finger millet. Based on the study it could be inferred that inclusion of one or two rows of millets in between pigeonpea lines spaced 90 cm apart is the most efficient and productive intercropping system under rainfed conditions.

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