Profitable alternate crops for bengalgram (*Cicer arietinum*) in scarce rainfall zone of Andhra pradesh

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ABSTRACT: A field experiment was conducted during *rabi* 2011-12 and 2012-13 at Regional Agricultural Research Station, Nandyal, Kurnool (Dt.), Andhra Pradesh to evaluate profitable alternate crops (jowar, sunflower, foxtail millet, black gram, mustard, soybean and safflower) to chickpea. The results clearly indicated that in both the years of study, significantly higher seed yield (1595 and 1760 kg ha^{-1}), maximum gross (Rs.55839 and 70408 ha^{-1}), net returns (Rs. 45,839 and 55,408 ha^{-1}) and B: C ratio (5.6 and 4.7) were recorded with chickpea among all the crops tested. However, among alternate crops evaluated, mustard and black gram resulted in significantly higher bengalgram equivalent yield (BGEY) (1129 and 1034 kg ha^{-1}; 853 and 1070 $kgha^{-1}$ during 2011-12 and 2012-13 respectively), net returns (Rs.32,021 and 28,701ha^{-1}; Rs.19,628 and 30,312 $kgha^{-1}$ during 2011-12 and 2012-13 respectively) and B:C ratio (5.3 and 4.8; 3.0 and 3.4 during 2011-12 and 2012-13 respectively) compared to other crops.

Key words: Bengalgram, alternate crops, vertisols

Chickpea (*Cicer arietinum* L.), grown in more than 50 countries, is rated as the largest produced food legume in South Asia and India contributes 65 and 68 % of global area and production respectively (Reddy and Mishra, 2010). In India, Andhra Pradesh registered a higher growth rate of chickpea production as compared to other states with an area of 3.44 lakh hectares and productivity of 1050 kg/ha. In Kurnool district of Rayalaseema in Andhra Pradesh, chickpea is grown as major crop during rabi season and recorded a faster growth during last five years owing to its low risk, less labour requirement due to suitability for mechanization from seed to seed operations and above all , high income fetching crop relative to traditional crops grown in the area. However, over the past few years, due to continuous mono cropping, there is a build up of pests like boll worm, that causes nearly 20-30% annual yield losses in India (Gaur *et al*., 2010) and diseases like wilt and root rots which are prevalent in hot and dry environment (Ali *et al.,* 1997); and are capable of reducing the yields considerably by establishing themselves either on alternate hosts or in soil, if proper crop rotation and management techniques are not followed. Moreover, extraction of nutrients from the same root zone depth every year due to monocropping leads to yield reduction subsequently and untapped nutrients in the soil can be made utilised by including crops with different root zone depths. Under these circumstances, crop rotation becomes a necessary technical component in order to retain the soil fertility status, avoid depletion of natural resources, development of pest and disease complex due to mono cropping. Hence, there is a need to evaluate alternate crops which include pulses and oilseeds

Table 1: Details of variety, seed rate, planting geometry, fertilization and irrigation scheduling in alternate crops

Crop	Variety	Seed rate (kg/ha)	Planting geometry	Recommended dose of fertilizer (kg/ha)			Number of irrigations and their schedule
				N	P_2O_5	K_20	
Jowar	NTJ-3	10	45 cm X 15 cm	60	40	30	2 at booting and milky grain stage
Sunflower	NDSH 1	5	60 cm X 30 cm	60	60	30	2 at rayfloret opening and seed development stage
Foxtailmillet	SiA 3085	5	22.5 X 7.5 cm	40	20	0	2 at flowering and grain formation stage
Blackgram	LBG 685	20	30 cm X 10 cm	20	50	0	2 at pre flowering and pod development stage
Mustard	SEJ 2	5	30 cm rows apart	60	30	0	2 at flowering and pod formation stage
Soybean	JS 335	75	45 cm X 5 cm	20	50	40	2 at pre flowering and pod formation stage
Safflower	NARI-6	10	45 cm X 20 cm	40	25	0	2 at rosette stage and seed development stage
Bengalgram	JG 11	75	30 cm X 10 cm	20	50	0	2 at pre flowering and pod development stage

for crop rotation that are profitable next to chickpea in Kurnool district of scarce rainfall zone of Andhra Pradesh and with this objective, the present study was taken up.

MATERIALS AND METHODS

Field experiment was conducted during *rabi* 2011-12 and 2012-13 at Regional Agricultural Research Station, Nandyal, Kurnool (Dt.), Andhra Pradesh on deep clay soil with pH– 8.5, organic carbon- 0.56%, available N 191, P 20.6 and K 498 kg /ha. The experiment was laid out in Randomized Block Design with three replications. The treatments consisted of different crops *viz*., jowar (*Sorghum bicolor*), sunflower (*Helianthus annuus*), foxtail millet (*Setaria italica*), black gram (*Vigna mungo*), mustard (*Brassica nigra*), soybean (*Glycine max*), safflower (*Carthamus tinctotius*) and bengalgram (*Cicer arietinum*). The gross and net plot sizes were 4.2 m x 5.4 m and 3.2 m x 4.2m, respectively. All the crops were sown on 16.11.2011 and 5.11.2012 during 2011-12 and 2012-13, respectively. The standard recommended package of agronomic practices for respective crops were followed (Table 1). Need based plant protection measures were taken up during the crop growth period. The amount of soil moisture at 15-30 cm depth at 30, 50 and harvest stage was estimated by gravimetric method as given by Black (1965). At harvest, the yield and yield attributes were recorded and analysed as per the procedure outlined by Gomez and Gomez (1984). The economics were worked out based on actual expenditure incurred and on the prevailing market prices.

RESULTS AND DISCUSSION

Soil moisture

It is apparent from the Table 2 that, there is a decline in soil moisture with the increase in crops growth. During 2011-12, variation in soil moisture at 30, 50 DAS and harvest stage of all the crops was statistically non significant. Further, at 30 and 50 DAS, black gram recorded numerically higher soil moisture (23.3 and 18.2% respectively) while bengalgram recorded lower soil moisture at 30, 50 DAS and at harvest (19.5, 17.1 and 14.1% respectively). Moreover, at harvest stage, maximum retention of soil moisture was noticed with soybean and jowar (15.9%). A similar trend of soil moisture was observed in 2012-13 at 30 and 50 DAS. However, at harvest, significantly higher soil moisture% was recorded with sunflower (20.3%) as compared to blackgram (14.5%), safflower (15.8%), bengalgram (16.2) and mustard (17.2%). The differential soil moisture in various crops might be attributed to the variation in evapotranspiration losses as influenced due to difference in crop growth and moisture extraction by roots.

Yield and Economics

During both the years of study, seed yield recorded with bengalgram (1595 and 1760 kg/ha during 2011-12 and 2012-13 respectively) was significantly higher than BGEY of black gram (1034 and 1070 kg/ha 2011-12 and 2012-13 respectively) and mustard (1129 and 833 kg/ha during 2011-12 and 2012-13 respectively) which in turn were significantly higher over bengalgram equivalent yields of the other

Table 2: Seed yield, bengalgram equivalent yield (BGEY), gross and net returns, B:C ratio and water productivity of alternate crops during 2011-12 and 2012-13

Treatments	Soil moisture (%)						Yield (kg/ha)		BGEY (kg/ha)		Gross returns (Rs/ha)		Net returns (Rs/ha)		B:C Ratio		Water productivity (kg/m^3)	
	2011-12			2012-13														
	DAS		At harvest	DAS		At harvest	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
	30	50		30	50													
Jowar	19.7	17.7	15.9	21.3	19.5	18.7	1407	1865	482	559	16884	22380	7884	7380	1.9	1.5	2.81	3.73
Sunflower	20.4	17.6	15.5	22.4	21.0	20.3	610	806	488	645	17080	25793	7080	10793	1.7	1.7	1.22	1.61
Foxtailmillet	21.4	17.6	15.6	23.6	21.1	20.0	1554	1821	577	637	20207	25491	13207	15491	2.9	2.5	3.11	3.64
Blackgram	23.3	18.2	15.3	20.0	15.5	14.5	1034	1070	1034	1070	36201	42812	28701	30312	4.8	3.4	2.07	2.14
Mustard	21.7	17.2	15.3	21.0	18.3	17.2	988	741	1129	833	39521	29628	32021	19628	5.3	3.0	1.98	1.48
Soybean	20.4	17.7	15.9	20.2	20.9	18.6	490	639	294	399	10290	15971	2790	5971	1.4	1.6	0.98	1.28
Safflower	21.6	17.7	15.9	21.2	17.6	15.8	909	1148	649	861	22730	34450	15730	24450	3.2	3.4	1.82	2.30
Bengalgram	19.5	17.1	14.9	20.4	17.3	16.2	1595	1760	1595	1760	55839	70408	45839	55408	5.6	4.7	3.19	3.52
SEm±	1.1	0.9	1.2	0.8	0.7	0.6	-	-	93	87	-	-	3258	4101	0.4	0.4	0.25	0.47
CD (P=0.05)	NS	NS	NS	NS	NS	1.8	-	-	284	266	-	-	9921	12425	1.2	1.2	0.77	1.05

crops tested. Across the years of study, bengalgram resulted in significantly higher gross returns (Rs.55, 839 and Rs.70,408 during 2011-12 and 2012-13 respectively) followed by mustard (Rs.39,521) and black gram (Rs.36,201) during 2011-12; and black gram (Rs.42,812) and safflower (Rs.34,340)during 2012-13. Similar trend was followed with B: C ratio.

Water productivity

Water productivity of different crops showed that (Table 2), significantly higher water productivity was recorded in bengalgram (3.19 kg/m^3) followed by foxtail millet (3.11 kg/m^3) and jowar (2.81 kg/m^3) during the year 2011-12. Whereas, in 2012-13, jowar recorded higher water productivity (3.73 kg/m^3) followed by foxtail millet (3.64 kg/m^3) and bengalgram (3.52 kg/m^3).

CONCLUSION

From the above study, it can be concluded that, none of the crops evaluated could compete with chickpea in terms of seed yield (1595 and 1760 kg ha^{-1}) and net returns (Rs. 45,839 and 55, 408 ha^{-1}). However, in view of yield stagnation of bengalgram, build up of pests and disease due to mono cropping in the traditional areas of Andhra Pradesh there is every need to have alternate crops for bengalgram for sustainability. Therefore, black gram and mustard can be grown successfully as alternate crops to discourage mono cropping and thereby avoiding build up of pests and diseases and attaining the sustainable production system.

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Received: May 1, 2020
Accepted: June 5, 2020