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Intercropping of castor and green gram under rainfed condition of North Gujarat

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ABSTRACT

An on-farm field experiment was conducted under during *Kharif* 2011-12 to 2015-16 at village - Kalimati/Dholiya, district - Banaskantha, Gujarat under care of All India Coordinated Research Project for Dryland Agriculture centre, Sardarkrushinagar Dantiwada Agricultural University to evaluate the effect of intercropping on climate change in participatory action research mode under dryland condition. The data indicated that the practice of intercropping of castor and green gram crop exerted their significant influence on seed and stalk/stover yields of castor. On the basis of pooled results, the practice of intercropping of castor + green gram (1:1) recorded significantly higher seed as well as stalk yields of castor i.e. 917 and 2011 kg/ha respectively as compared to its sole cropping. Further, the higher net return of Rs. 64934/ha and benefit cost ratio (4.96) were secured with intercropping. Similarly, the castor equivalent yield (1671 kg/ha) was also recorded higher when it was intercropped with green gram.

Key words: Dryland, Rain water use efficiency, Intercropping, Land equivalent ratio and on-farm trial

Castor (*Ricinus communis* L.) is an important industrial oilseed crop, finds a prominent place in dryland agriculture cropping systems of North Gujarat, because of its drought resistance through deep root system, wax coating on the shoot and quick growth. Since, the dryland crop's productivity is further comparatively less because of low and erratic rainfall and poor adoption of improved technologies. To viaduct this gap, the crop diversification is required for increasing the productivity and profitability per unit area and per unit time where intercropping systems amuse an important responsibility in subsistence and food production (Ramachandrappa, *et al*. 2016). Intercropping is also an efficient strategy that can be followed with desirable outcomes in the present climate change scenario (Venkateswarlu and Shankar, 2009). In cropping system approach to agriculture, complementary arise due to better utilization of resources (below ground and above ground) both in temporal and spatial dimensions as in case of intercropping. The benefits in terms of enhanced produce per unit area and time accrue due to duration differences, rooting systems and crop canopy/stature variations in intercropping system as opposed to sole cropping. Castor is grown mainly in dryland areas of Gujarat. It is grown mostly as pure crop and to some extant as intercrop. To improve the crop productivity and economic status of the farmers under such conditions, the “National Innovations on Climate Resilient Agriculture (NICRA)” project was initiated by ICAR-CRIDA.

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Based on an on-farm testing approach, the improved practice of intercropping in rainfed crops developed under this project have been tested at farmers field conditions during the years 2011 to 2015. A statistical assessment of the superiority of improved practice i.e. intercropping of castor and green gram crops compared to their sole cropping has been attempted in this research.

MATERIALS AND METHODS

The field experiment was conducted to find out the effect of in-situ conservation of rain water on climate change effect at on-farm in participatory action research mode under dryland condition in the village - Kalimati/Dholiya, district - Banaskantha under NICRA project through the All India Coordinated Research Project for Dryland Agriculture centre, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *Kharif* 2011-12 to 2015-16. The soil was loamy sand to sandy clay loam in texture having low soil available nitrogen 212 kg/ha and available phosphorus 33.5 kg/ha from 15 cm depth. The soil was slightly saline in reaction (pH 7.2 - 7.7). The experiment was comprised of three treatments of intercropping i.e. T_1**:** Castor + Green gram (1:1), T_2**:** Castor sole and T_3**:** Green gram sole which were replicated twenty times in randomized block design. In intercropping, castor was sown with the spacing of 90 cm × 60 cm whereas, green gram was sown in between two rows of castor by maintaining 1:1 row ratio. Recommended dose of nitrogen and phosphorus fertilizers (60:40 kg/ha for castor and 20:40 kg/ha for green gram) were applied to the respective crops through urea and diammonium phosphate. The nitrogen was applied to castor crop in two equal splits; first at the time of sowing and second at 40-50 days after sowing while, whole quantity of nitrogen and P_2O_5 were applied to green gram in a single dose as basal at the time of sowing. The observations were recorded on seed and stalk/stover yields as well as economics of castor and green gram crops after harvest.

The intercropping efficiency was analyzed using the land equivalent ratio (LER) and the area time equivalent ratio (ATER) as detailed below:

$$\text{Land equivalent ratio} = \frac{(Yab)}{Yaa} + \frac{(Yba)}{Ybb}$$

Where, Yaa and Ybb were sole yield of crops 'a' and 'b' respectively, Yab and Yba were mixture yield of crops 'a' and 'b' respectively (Willey, 1979).

RESULTS AND DISCUSSION

Intercropping of castor and green gram influenced the yield of castor as compared to its respective sole cropping.

Productivity:

The result (Table 1) emanated that castor yield recorded comparatively higher when it was intercropped with green gram then its sole cropping during the years 2011-12 to 2015-16 and in pooled results. As far as mean data are concerned the highest seed (917 kg/ha) and stalk (2011 kg/ha) yields of castor was recorded in intercropped with green gram, respectively as compared to its sole cropping (783 kg/ha seed and 1639 kg/ha stover). The increase in castor seed and stalk yields with intercropping of green gram could be attributed to the vigorous growth of intercrops, which showed the gracious effect on castor crop even in the limited supply of soil

moisture. The performance of castor was firmly affected by intercropping of green gram as compared to castor sole.

Differently, sole green gram recorded comparatively higher yields to its respective sole cropping. The castor + greengram (1:1) recorded lesser seed (405 kg/ha) and stover (920 kg/ha) yields of green gram as compared to its sole cropping (724 kg/ha seed and 1665 kg/ha stover yield).The yield of green gram was reduced when sown as intercrop with castor which is due to 50% reduction in plant population and to some extent competed for the limited supply of soil moisture.

Castor equivalent yield:

Castor equivalent yield significantly affected due to intercropping and maximum was recorded with castor + green gram (1:1) compared to their respective sole cropping. The castor crop with green gram recorded significantly the highest equivalent yields of 1649, 1690, 2295, 1581, 1267 and 1671 kg/ha for the years 2011, 2012, 2013, 2014, 2015 and in pooled data, respectively (Table 2). Yield of sole castor was recorded statistically less as compared to intercropping, which indicated that under drought situation, sole cropping of castor is not as good as than its intercropping with green gram. The higher castor equivalent yield with green gram intercropping was due to higher additional seed and stover yields of green gram. These results are in agreement with the findings of Ramachandrappa et al. (2016) and Manoj *et al.,* (2013).

Rain water use efficiency (RWUE):

The green gram intercropped with castor, i.e. the castor + green gram intercropping system recorded substantially higher RWUE (2.42 kg/ha-mm), the lowest RWUE (2.21 kg/ha-mm) was being recorded in case of castor sole (Fig. 1). The higher RWUE of intercropping was done to the fact that the plants were able to utilize all the available water from different layers of the soil. Similar results were observed by Rao et al. (2010) in sorghum and Ramachandrappa et al. (2016) in castor.

Land Equivalent Ratio (LER):

On the basis of mean data of intercropping efficiency, maximum land equivalent ratio (1.86) was recorded with castor + green gram (1:1) intercropping system, which indicated the more efficient use of land than sole cropping of castor. In the years 2011, 2012, 2013, 2014 and 2015 castor + green gram was proved to be advantageous than sole cropping system (Table 3). It was due to higher intercrop yield and a lower reduction in base crop yield. These results are in conformity with Patel *et al.*, (2007), Mudalagiriyappa *et al.*, (2011) and Ramachandrappa et al., (2016).

Profitability:

The intercropping of green gram with castor crop recorded higher net return (`64934/ha) as compared to its sole cropping (Fig. 1). The corresponding rise in net return was due to increase in yield of castor and green gram intercropping system over its sole cropping, which resulted to bring out better use of natural resources viz., sunlight, land and water. The

results are in conformity with the findings of Patel et al., (2007).

CONCLUSION

It is concluded that intercropping of green gram (One row in between two rows of castor grown at 90 cm spacing) is a highly remunerative in castor and thus it can be convinced to the farmers about fitness of the improved technology. The maximum yield and net return obtained with the improved practice in different years have also motivated other farmers in the villages for a large scale adoption in the semi-arid area of Banaskantha district of Gujarat.

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Table 1a Effect of castor and green gram intercropping on seed yield

Treatments		Seed yield (kg/ha)											
		2011-12		2012-13		2013-14		2014-15		2015-16		Pooled	
		Castor	Green gram	Castor	Green gram	Castor	Green gram	Castor	Green gram	Castor	Green gram	Castor	Green gram
T_1 : Castor + Green gram (1:1)	Seed	966	360	901	423	1275	560	820	410	750	270	917	405
T_2 : Castor sole	Seed	781	-	729	-	1084	-	660	-	465	-	783	-
T_3 : Green gram sole	Seed	-	655	-	757	-	985	-	718	-	495	-	724

Table 1b Effect of castor and green gram intercropping on stalk/stover yield

Treatments		Stalk/Stover yield (kg/ha)											
		2011-12		2012-13		2013-14		2014-15		2015-16		Pooled	
		Castor	Green gram	Castor	Green gram	Castor	Green gram	Castor	Green gram	Castor	Green gram	Castor	Green gram
T_1 : Castor + Green gram (1:1)	Stalk/ Stover	2600	814	1801	1015	2520	1070	1650	970	1645	730	2011	920
T_2 : Castor sole	Stalk	1723	-	1457	-	2272	-	1335	-	1160	-	1639	-
T_3 : Green gram sole	Stover	-	1484	-	1840	-	1926	-	1740	-	1334	-	1665

Table 2 Effect of castor and green gram intercropping on castor equivalent yield

Treatments	Castor equivalent yield (kg/ha)					
	2011-12	2012-13	2013-14	2014-15	2015-16	Pooled
T_1 : Castor + Green gram (1:1)	1649	1690	2295	1581	1267	1671
T_2 : Castor sole	806	751	1118	680	482	807
T_3 : Green gram sole	1172	1365	1734	1295	903	1297
SEm±	43	37	46	45	25	42
CD at 5%	122	106	132	128	71	120
CV %	15.81	13.00	12.01	16.92	12.53	14.72
Rainfall (mm)	1028.8	859.0	949.0	638.0	999.4	894.8
Rainy days	34	22	37	24	22	28

Table 3 Effect of castor and green gram intercropping system on land equivalent ratio

Treatments	Land Equivalent Ratio					
	2011-12	2012-13	2013-14	2014-15	2011-12	Mean
T_1 : Castor + Green gram (1:1)	1.92	1.79	1.7	1.8	1.92	1.86
T_2 : Castor sole	1.00	1.00	1.00	1.00	1.00	1.00
T_3 : Green gram sole	1.00	1.00	1.00	1.00	1.00	1.00

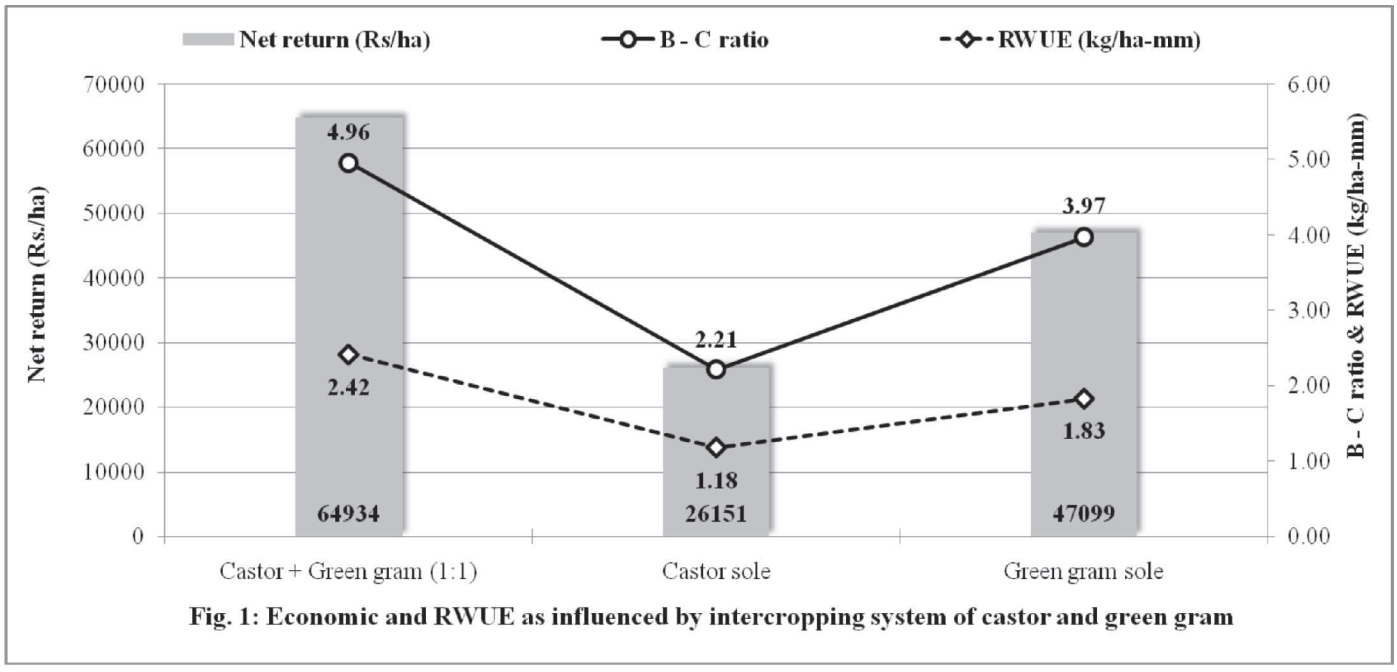

Fig. 1: Economic and RWUE as influenced by intercropping system of castor and green gram