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Climate Resilient Intercropping System under Drought Condition in NICRA Village of Marathwada Region of Maharashtra

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Abstract: ***In rainfed and dry regions of Marathwada, sole cropping is not much remunerative in the present scenario of climate change in agriculture to fulfill the diverse demands of consumers and burgeoning population. Hence, studies on intercropping systems were conducted in NICRA cluster villages of Aurangabad district from the period 2014 to 2016 as part of National Innovations in Climate Resilient Agriculture (NICRA). In this location Bt Cotton +Green gram/Black gram (1:1) recorded higher yield and economics as compared to the farmers practice of growing sole Bt Cotton crop. The yield observations were recorded at the harvest of the respective crops. The yields of intercrops were converted into main crop equivalent yields taking into account the actual yields (kg/ha) attained by crops along with the prices (per kg)of the crops. The data were subjected to "t" test analysis for determining its significance between the treatments and to draw valid conclusions. The level of significance used was 5%. The rainwater use efficiency (kg/ha-mm) of a crop or cropping system was determined by considering the crop equivalent yield(kg/ha) attained by the system and crop seasonal rainfall (mm)received from sowing to harvest of a given crop or the long duration crop in the cropping system. This intercropping system in Bt. cotton has wider scope to upscale in all districts of Marathwada region of Maharashtra in assured rainfall zone and scarcity zone area through cluster frontline demonstration on pulse programme under NFSM. Improved variety of green gram BM-2003-2 and black gram TAU-1 & BDU-1 need to be included in the pulse production programme for enhancing the production of Green gram and Black gram ultimately pulses. Hence, adoption of intercropping systems in rainfed black soils is climate resilient system and also helps in improving food security in rainfed areas.***

Keywords: B: C ratio, Climate resilience, Intercropping, Rain water use efficiency, Drought condition.

1. Introduction

In India, 60percent of total cultivated area is managed as rainfed ecosystem, wherein crop production is dependent on rainfall, having no facility for protective or lifesaving irrigation. India ranks first among the rainfed agricultural countries of the world in terms of both extent and value of produce. Rainfed agriculture supports 40percent of the national food demands. These areas receive an annual rainfall between 400 mm and 1000 mm, which is unevenly distributed, highly uncertain and erratic. As a result, a significant fall in food production is often noticed. The rainfed agriculture as such is most impacted by climate change (Ashalatha *et al.,* 2012). Rainfall behaviour, temperature fluctuation and wind are becoming routine aberrations under rainfed ecosystem because of climate change. Added to this, reduced number of rainy days and increased rainfall intensity resulting in heavy crop losses need serious attention to bring stability of rainfed ecosystems. Intercropping is an important aspect to combat the crop failure in rainfed agriculture under the situation of climate change and helps in improving productivity and profitability through efficient utilization of natural resources. Intercropping provides insurance against drought, modifies soil environment, improves moisture and radiation use, ensures better weed control, reduces disease and pest incidence and on the whole increases and stabilizes the productivity. Intercropping has been identified as a kind of biological insurance against risks

Under aberrant rainfall behavior. Crop diversification is also necessary to get higher yield and return besides maintaining soil health apart from other benefits (Siddique *et al.,* 2012). Climate risk is an integral part of agriculture and in each season farmers are encountering production risks such as weather pest disease and technology etc. Managing crop for excessive and deficit rainfall such as improved crops and cultivars, cropping system and other management practices is necessary for stable profitability in rainfed areas. Among all factors of production improved cultivars play important role in enhancing the productivity in rainfed environment. In this regard, study was undertaken to evaluate different cereal, pulse based intercropping systems in selected villages of Aurangabad district

2. Materials and Methods

Three demonstration sites covering three villages (Shekta, Wajnapur, Buttewadgaon) of Aurangabad district were selected for the study from the period of 2014-2016. The steps for selection of villages in Aurangabad districts include climatic constraints of the area, assessment of natural resources, farming situations, constrains in crop production, climatic vulnerability, yield gaps and opportunities for adaptations to climate change. The demonstrations on

improved intercropping systems along with sole crops were conducted in 0.4 ha area on each farmer's site in all selected villages in participatory mode. The economic analysis of input and output relationships and grain equivalent yields were worked out to quantify the benefits of intercropping systems for the last three years. Action plans to demonstrate appropriate intercropping systems to mitigate the climatic vulnerability preferably drought was implemented in farmers' fields in a participatory research mode involving scientists under National Innovations in Climate Resilient Agriculture (NICRA). The details of villages selected for the purpose of study along with soil types and normal rainfall and climate vulnerabilities are presented in Table.

Table 1: Site characteristics of NICRA of selected villages

District	NICRA village	Soil type	Annual rainfall	Climate variability
Aurangabad	Shekta, Wajnapur, Buttewadgaon	Medium to Heavy soil	644	Drought

The demonstrations of improved intercropping systems along with sole crops were conducted in farmers' fields in the selected districts (Table 2). Farmers in the demonstration villages were selected based on their willingness to engage in participatory research. Before conducting the demonstrations, list of farmers was prepared in group meetings and specific skill training was given to the selected farmers during pre-*kharif*. Selected farmers participated in each and every research intervention from soil sampling to harvest. Timely sowing, maintenance of required spacing and plant population, timely weeding and plant protection were attended as per the instructions of scientists.

Climatic conditions

In NICRA village cluster of Aurangabad district during 2014, 327 mm rainfall was received in 33 rainy days, as against normal rainfall of 644 mm which was 49 percent lower than the normal. During 2015, rainfall pattern was highly erratic and uneven with 388 mm rainfall received in 25 rainy days.. In 2016 rainfall distribution sufficient as compared to previous year 516 mm with 27 rainy days. Which was 20 percent lower than normal rainfall. Overall out of 3years of studies the rainfall was deficit. In an assessment of intercropping system, Bt Cotton+Green gram(1:1)&Bt Cotton+Black gram were demonstrated in participatory mode NICRA involving 120 farmers in 48 ha in NICRA cluster village of Aurangabad district from 2014 to2016.

Table 2: Area and number of farmers under different cropping systems

Year	Bt Cotton+Green gram Intercropping		Bt Cotton+ Black gram Intercropping	
	No. of farmers	Area(ha)	No. of farmers	Area(ha)
2014	20	08	20	08
2015	20	08	20	08
2016	20	08	20	08
Total	60	24	60	24

The yield observations were recorded at harvest of the respective crops. The yields of intercrops were converted into main crop equivalent yields taking into account the actual yields (kg/ha) attained by crops along with the prices (per kg) of the crops. The data were subjected to "t" test analysis for determining its significance between the treatments and to draw valid conclusions. The level of significance used was 5%. The rainwater use efficiency (kg/ha-mm) of a crop or cropping system was determined by considering the crop equivalent yield (kg/ha) attained by the system and crop seasonal rainfall (mm) received from sowing to harvest of a given crop or the long duration crop in the cropping system. It is given as a ratio of the crop equivalent yield to that of crop seasonal rainfall. The cost of cultivation (Rs/ha) incurred under different cropping systems was derived by taking into account all the costs involved for different agricultural inputs and operations. The values of different crops in sole and intercropping systems were considered to derive the gross returns (Rs/ha). The prices of farm produce in different years are presented in Table 3.

$$\text{Crop Equivalent Yield (kg/ha)} = \text{Yield of main crop (kg/ha)} + \left[\frac{\text{Yield of inter crop (kg/ha)} \times \text{Price of intercrop Rs/kg}}{\text{Price of main crop (Rs/kg)}} \right]$$

3. Results and Discussion

Cotton +Green gram based intercropping system

Under NICRA in three cluster villages of Aurangabad district, intercropping of BT Cotton +Green gram (1:1) recorded higher equivalent yield by 2090, 2213 and 2248, kg/ha than farmer practice of Cotton Sole cropping system during 2014, 2015 and 2016, , respectively. On an average, the intercropping system of Bt Cotton+ Green gram (1:1) recorded significantly higher Cotton equivalent yield (2184kg/ha) and B:C ratio (3.31) as compared to Cotton Sole crop(Table 4).

Table 3: Price of agriculture produce during the years of study Produce

Produce	Price Rs/kg		
	2014	2015	2016
Bt. Cotton	40	41	55
Green gram	50	51	45
Black gram	41	51	74

Cotton +Black gram based intercropping system

Similarly observation were also recorded of Cotton +Black gram based intercropping system

Under NICRA in Three cluster villages of Aurangabad district, intercropping of Bt. Cotton +Black gram (1:1) recorded higher equivalent yield by 1919, 1870and 2343 kg/ha than farmer practice of Cotton sole cropping system during 2014, 2015 and 2016, , respectively. On an average, the intercropping system of Bt Cotton+ Black gram (1:1) recorded significantly higher Cotton equivalent yield (2044 kg/ha) and B:C ratio 3.20) as compared to Cotton sole crop(Table 5).

Table 4: Yield and economics of Bt Cotton based Green gram intercropping system

Years	Treatments	Yield of main crop (kg/ha)	Yield of intercrop (kg/ha)	Cotton Equivalent yield (kg/ha)	RWUE (kg/ha-mm)	Gross return (Rs. /ha)	Net Returns (Rs. /ha)	B:C Ratio
2014	Bt. Cotton+ Green gram	1340	600	2090	6.39	83600	55300	2.95
2015	Bt. Cotton+ Green gram	1380	670	2213	5.70	90733	59140	2.87
2016	Bt. Cotton+ Green gram	1749	610	2248	4.35	123640	93525	4.10
Mean		**1490**	**627**	**2184**	**5.48**	**99324**	**69322**	**3.31**
t-value for Cotton equivalent yield- 13.34**								

Table 5: Yield and economics of Bt Cotton based Black gram intercropping system

Years	Treatments	Yield of main crop (kg/ha)	Yield of intercrop (kg/ha)	Cotton equivalent yield (kg/ha)	RWUE (kg/ha-mm)	Gross return (Rs. /ha)	Net Returns (Rs. /ha)	B:C Ratio
2014	Bt. Cotton+ Black gram	1330	575	1919	5.86	76760	48870	2.75
2015	Bt.Cotton+ Black gram	1310	450	1870	4.81	76670	45870	2.49
2016	Bt.Cotton+ Black gram	1684	490	2343	4.54	128865	99435	4.38
Mean		**1441**	**505**	**2044**	**5.07**	**94098**	**64725**	**3.20**
t-value for Cotton equivalent yield-10.55**								

Table 6: Yield and economics of Bt Cotton sole cropping system

Years	Treatments	Yield of main crop (kg/ha)	RWUE (kg/ha-mm)	Gross return (Rs. /ha)	Net Returns (Rs. /ha)	B:C Ratio
2014	Bt. Cotton sole cropping	1550	4.74	62000	35490	2.34
2015	Bt. Cotton sole cropping	1150	2.96	47150	17950	1.61
2016	Bt. Cotton sole cropping	2000	3.87	110000	81450	3.85
Mean		**1567**	**3.86**	**73050**	**44963**	**2.60**

4. Conclusion

In an assessment of intercropping systems of Bt. Cotton+ Green gram& Cotton+ Black gram in NICRA villages of Aurangabad District were found to be economical and climate resilient in dryland situations. Hence, intercropping system offers solution to obtain higher productivity, diversified food products and reduced risk of crop failure under rainfed conditions.

References

[1] M.N.Thimmegowda1, B.K.Ramachandrappa1, K. Devaraja1, M.S. Savitha1, P.N. Srikanth Babu1, K.A. Gopinath2, G. Ravindra Chary2 and Ch. Srinivasa Rao2.(2016)climate resilient intercropping systems for rainfed red soils of Karnataka *Indian J. Dryland Agric. Res. & Dev. 31(2):39-44.*

[2] Adikant Pradhan, Rajput AS and Thakur A. (2014). yield and economics of finger millet (*Eleusinecoracana L. Gaertn*) intercropping system. Int. J. Curr. Microbiol. Appl. Sci., 3(1): 626-629.

[3] Ashalatha KV, Munisamy, Gopinath and Bhat ARS. (2012). impact of climate change on rainfed agriculture in India: A Case Study of Dharwad. Int. J. Environ. Sci. Dev., 3(4): 368-371.

[4] Siddique KHM, Johansen C, Turner NC, Jeuffroy MH, HashemA, Sakar D, Gan Y, Alghamdi SS. (2012). Innovations in agronomy for food legumes- A review. Agron. Sustainable Dev., 32: 45-64.

[5] Sharma Arjun, Pujari BT, Suhasyelshetty and Dharmaraj PS. (2004). Studies on pigeon pea based intercropping systems with small millets, bajra and green gram under shallow black soil Karnataka *J. Agric. Sci., 17: 544-547*

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