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EVALUATION OF *NAVADHANYA* CROPS UNDER STRIP CROPPING IN FARMERS' FIELD

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ABSTRACT

A field experiment entitled "Evaluation of *navadhanya* crops under strip cropping in farmer's field" was conducted on farmer field at Sanyasipalle village in Chittor district of Andhra Pradesh during *kharif* 2019. Field experiment was conducted with three cropping systems as treatments, *viz.*, T_1- Groundnut + red gram (7:1) intercropping system, T_2- *Navdhanya* as per farmers practice and T_3- *Navdhanya* crops sown under strip cropping. Results revealed that groundnut + red gram (7:1) intercropping recorded maximum RGSEY (1102 kg ha^{-1}), maximum gross returns (₹ 75650 ha^{-1}), maximum net returns (₹ 43199 ha^{-1}) and benefit-cost ratio (2.33) compared with navadhanya as per farmers practice and under strip cropping.

KEYWORDS: *Navadhanya* crops, intercropping, strip cropping, net returns and gross returns.

INTRODUCTION

Groundnut is an important commercial oilseed crop grown by Chittoor District farmers during *kharif* on *alfisols* under rainfed conditions. Unusual monsoon behavior is one of the crucial elements for crop yield in rainfed environments. Due to a delayed monsoon and protracted intermittent dry spells, the practice of growing groundnuts exclusively in the rainy season is occasionally found to be fairly unsafe. A feasible approach to deal with the issue is to stabilize the output of dry-land crops through the widely used technique of intercropping suitable crops. Intercropping has long been acknowledged as a form of biological assurance for vulnerabilities and abnormal rainfall behavior in dryland environments. It increases the cropping intensity, productivity, profitability, optimum utilization of soil, water, nutrients and sunlight (Kumar and Singh, 2006).

In the past, mixed and poly-cropping systems, known regionally by a diverse range of names, were prevalent over the Indian subcontinent (IAASTD, 2009; La Via Campesina, 2010; Deb, 2021). Rainfed farmers of Rayalseema region, which includes the districts of Anantapuram, Chittor, Kadapa, and Kurnool in the southern Indian state of Andhra Pradesh, has one such ancient cropping technique called *Navadhanya*. *Navadhanya* is a mixed farming technique evolved by farmers in the dryland region to successfully tackle and use the irregular rainfall they receive throughout the year. The cropping system is a combination of diverse millets, pulses, and oilseeds grown concurrently, which keeps land cover 9-10 months of the year and provides different food and fodder crops to meet the food and nutrition needs of households and cattles, as well as adequate organic waste for crop nutrition, making it a wonderful sustainable dryland cropping system.

However, present agricultural systems are rapidly shifting toward monocrops (IOPEPC, 2017). It's probable that the move from a mixed or poly-cropping system to a mono-cropping system had a range of repercussions on these small-marginal rainfed farmers (Naidu, *et al* 2019). According to research, farmers who grow peanuts as an irrigated monoculture are particularly vulnerable to suffering losses because of the relatively low returns, high risk of crop failure due to erratic rainfall, and unstable market prices (Kumar and Subramanyachary, 2015; Naidu, *et al* 2019).

Groundnut + red gram in 7:1 or 11:1 intercropping system is the normal practice followed by farmers in *alfisols* under rainfed conditions. *Navadhanya* crops sown under mixed cropping system have certain field problems. Hence, to avoid the operational problems it is pertinent to evaluate different *navadhanya* crops under strip cropping deserves priority. In this view, a field experiment is planned in farmer's field to study the performance of different millets, pulses and oilseeds and identify compatible crops under *navadhanya* as per farmer practice and strip cropping of *navadhanya* crops.

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MATERIAL AND METHODS

A field experiment entitled "Evaluation of *navadhanya* crops under strip cropping in farmer's field" was conducted on farmer field at Sanyasipalle village in Chittoor district of Andhra Pradesh during *kharif* 2019. Field experiment with three cropping systems were used as treatments, *viz.*, T_1- Groundnut + red gram (7:1) intercropping system, T_2- *Navdhanya* as per farmers practice (mixed cropping of red gram, sorghum, field bean and groundnut) and T_3- *Navdhanya* crops (green gram, cowpea, sorghum, pearl millet, finger millet, castor, field bean, red gram and foxtail millet) sown under strip cropping with one row of red gram after every strip of *navadhanya* crop. The experimental farmer's field soil was sandy loam in texture, neutral in reaction (pH - 6.6), low in organic carbon (0.38%), low in available nitrogen (216 kg ha^{-1}), medium in available phosphorus (29.6 kg ha^{-1}) and medium in potassium (278 kg ha^{-1}). The crop varieties used for the study, row-to-row spacing, plant-to-plant spacing and recommended dosage of fertilizers were presented in Table 1. The plots of 32 m × 3.7 m size were used for each treatment. All of the management techniques for different crops were implemented as per the zonal reports of southern zone of Andhra Pradesh. All three cropping systems analyzed on the basis of system equivalent yield, returns and benefit-cost ratio.

The following formulas were used for calculating equivalent yield of crops and cropping systems

Redgram Seed equivalent Yield (RGSEY) =

$$\frac{\text{Yield of intercop} \times \text{Price of intercrop}}{\text{Price of redgram (₹ kg}^{-1})}$$

Equivalent yield of system =

Yield of redgram + Redgram seed equivalent yield

RESULTS AND DISCUSSION

Yield

Maximum red gram seed equivalent yield (1102 kg ha^{-1}) was recorded when groundnut intercropped with red gram in 7:1 (T_1) (Table 2), which was 45.7 per cent and 251.8 per cent higher over *navadhanya* cropping system as per farmers practice and *navadhanya* crops sown under strip cropping, respectively (Table 3 and 4). Groundnut with red gram intercropping resulted in highest yield because of maximum and efficient utilization of growth resources by both crops coupled with better agronomic management. The findings corroborate those of Chandrika *et al*. (2001), who found that groundnut + red gram (7:1) intercropping produced higher net returns and total yield advantage than sole groundnut crop in rainfed *alfisols*. Similar outcomes were noted by Chaudhari *et al.* (2017) and Dutta & Bandyopadhyay (2006). Among

Table 1. Details of cultivation of *navadhanya* crops

Crops	Variety	Spacing (cm)	NPK (kg ha^{-1})
Groundnut (*Arachis hypogaea*)	Dharani	30 × 10	20:50:00
Red gram (*Cajanus cajan*)	TRG - 59	60 × 20	20:50:00
Field bean (*Lablab purpureus*)	TFB - 2	60 × 20	20:50:00
Sorghum (*Sorghum bicolor*)	CSH - 6	30 × 10	80:40:30
Pearl millet (*Penisetum americanum*)	ICTP - 8203	30 × 10	80:40:30
Cowpea (*Vigna anguiculata*)	TPTC - 29	30 × 10	20:50:00
Green gram (*Vigna radiata*)	WGG - 42	30 × 10	20:50:00
Finger millet (*Eleusine coracana*)	Vakula	22.5 × 10	60:30:20
Castor (*Ricinus communis*)	Haritha	90 × 60	45:40:30
Foxtail millet (*Setaria italica*)	SiA-3085	22.5 × 10	20:20:20

Table 2. Performance of groundnut + red gram (7:1) (control – rainfed) during *kharif* 2019

Crops	Pod and seed yield (kg ha^{-1})	RGSEY (kg ha^{-1})	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C ratio
Groundnut	1179	1513	75650	43199	2.33
Redgram	75	-	-	-	

Table 3. Performance of *navadhanya* as per farmers practice during *kharif* 2019

Crops	Pod /Seed yield (kg ha^{-1})	RGSEY (kg ha^{-1})
Groundnut	661	806
Redgram	50	50
Field bean	20	10
Sorghum	8621	172

Table 4. Performance of *navadhanya* crops under strip cropping during *kharif* 2019

Crop	*Navadhanya* crop yield (kg ha^{-1})	Redgram seed Yield (kg ha^{-1})	RGSEY (kg ha^{-1})	Gross income (₹ ha^{-1})	Net income (₹ ha^{-1})	BC ratio
Greengram (seed)	41	4	53	2650	665	1.34
Cowpea (fodder)	566	6	23	1150	-835	0.58
Sorghum (fodder)	2572	6	58	2900	1972	3.13
Pearl millet (fodder)	617	4	16	800	-897	0.47
Finger millet	4	6	8	400	-1214	0.25
Castor beans	82	2	60	3000	1344	1.81
Field bean veg	103	5	57	2850	2249	4.74
Redgram seed	4	2	6	300	-329	0.48
Foxtail millet	284	6	148	7400	5963	5.15

strip cropping of red gram with *navadhanya* crops (T_3) red gram + foxtail millet resulted in maximum RGSEY followed by red gram + castor strip intercropping system. Lowest RGSEY was recorded with red gram + finger millet strip row intercropping and red gram + red gram strip intercropping system (Table 4).

Economics

Among all three cropping systems groundnut intercropping with red gram (7:1) recorded highest gross returns (75650 ₹ ha^{-1}) , net returns (43199 ₹ ha^{-1}) and benefit-cost ratio (2.33). Lowest gross returns and net returns was recorded with *navadhanya* crops sown under strip cropping, but lowest benefit-cost was recorded with *navadhanya* as per farmer practice (Table 5). Among strip cropping of *navadhanya* crops with red gram, highest gross return (7400 ₹ ha^{-1}), net return (5963 ₹ ha^{-1}) and benefit-cost ratio (5.15) was recorded with red gram with foxtail millet and lowest with red gram +

Table 5. Yield, gross return, net return and benefit-cost ratio of *navadhanya* crops under different cropping systems during *kharif* 2019

Treatments	Red gram seed equivalent yield (kg ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
T_1 : Groundnut + red gram (7 : 1) intercropping system	1513	75650	43199	2.33
T_2 : *Navdhanya* as per farmers practice	1038	51921	13220	1.34
T_3 : *Navdhanya* crops sown under strip cropping	430	21450	8198	1.71

finger millet strip row intercropping and red gram + red gram strip intercropping system (Table 4).

Groundnut intercropping with red gram in 7:1 ratio is best cropping system for rainfed conditions in *alfisols* of Andhra Pradesh. Strip cropping of red gram along with foxtail millet and field bean may also resulted in high returns and benefits to farmers. However, expressed satisfaction with the performance of crops under *navadhanya* and desired for mechanization for reducing cost of production.

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