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EVALUATION OF CROP DIVERSIFICATION AND INTENSIFICATION OPTIONS FOR ENHANCING RESOURCE USE EFFICIENCY, SYSTEM PRODUCTIVITY AND FARM INCOME IN FCV TOBACCO GROWING BLACK SOIL REGION OF ANDHRA PRADESH

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Crop diversification and intensification finds an important place in the strategy of dealing with risk and uncertainty related to climate change, soil degradation and inefficient use of natural resources. It helps to increase the resilience of farmers through significant improvement in utilization of natural resources, system productivity and farm income. In view of this an field experiment was carried out at ICAR-CTRI, Black soil research farm, Katheru, Rajahmundry to evaluate the crop intensification and diversification options with inclusion of high value crops and cropping systems for higher system productivity, resource use efficiency and farm income. Results revealed that higher system productivity based on tobacco leaf equivalent yield (TLEY) was recorded under chilli (2588 kg/ha) followed by turmeric (2531 kg/ha) sole crops compared to foxtail millet-tobacco (1888 kg/ha), finger millet-tobacco (1869 kg/ha) and existing fallow-tobacco system (1655 kg/ha). Chilli and turmeric are also recorded highest relative production efficiency (RPE of 55.4 % and 52.0% respectively), relative economic efficiency (REE of 65.3% and 47%, respectively) over the existing fallow-tobacco system. Finger millet-tobacco (67%), Foxtail millet-tobacco (61%), turmeric (64%) and chilli (58%) recorded highest land use efficiency compared to the fallow-tobacco system (37%).

INTRODUCTION

Tobacco (*Nicotiana tobacum* L.) is an important commercial crop grown in India. Tobacco crop is cultivated in an area of 4.33 lakh hectares covering 15 states with production of 750 M kg during 2021. Tobacco offers significant employment and livelihood opportunities (both on-farm and off-farm) to millions in India. The Flue-cured Virginia tobacco (FCV) is a major tobacco type grown in an area of 1.45 lakh hectares in the states of Andhra Pradesh and Karnataka accounts for 30% of total production. FCV tobacco is mainly grown during *rabi* season by making use of conserved soil moisture in black soils regions covering Guntur, Krishna, Prakasam, East Godavari districts of Andhra Pradesh. Though tobacco makes significant contribution to the economy, there are several emerging issues like resource degradation, climate change, deforestation and escalation of production costs that affects farmers' income (Reddy and Prasad, 2016).. To address all these concerns, crop diversification and intensification is one of the important approaches for enhancing resource use efficiency, system productivity and profitability and soil health (Kumar et al., 2020). Crop or cropping system diversification refers to a shift from often a less productive, less resilient and less sustainable crop or cropping system to a more productive, resilient and sustainable system (Reddy, 2016). The shift is usually in response to specific farm goals and this may include new market avenues, soil fertility improvement. pests and diseases control increasing crop productivity and stabilizing the income of farmers (Reddy, 2016). Crop diversification is also used as an insurance against a possible crop failure (Rusinamhodzi et al., 2012). Crop diversification considered to be a key pathway to sustainable intensification of crop production (Vanlauwe et al., 2014). In FCV tobacco growing black soil region, crop intensification with crops like foxtail millet and finger millet during rainy (*kharif*) season followed by tobacco during post-rainy (*rabi*) season and diversification with high value commercial crops like chilli and turmeric are best available options instead of fallow tobacco which is generally followed by the farmers over the years. In view of this an experiment has been planned at ICAR-CTRI, Rajahmundry, to find out suitable crop and

Key words: Crop diversification, intensification, FCV tobacco

cropping system with higher resource use efficiency, system productivity and farm income in comparison to fallow-tobacco in tobacco growing black soil regions of Andhra Pradesh.

MATERIAL AND METHODS

Fixed plot field experiment was conducted during 2019-20 cropping season at at research farm of Central Tobacco Research Institute, Rajahmundry, (16° 59' N and 81 48' E at 25.3 m above mean sea level) in East Godavari district of Andhra Pradesh. It is a hot dry, sub humid semi arid tropical climate with an average annual rainfall of 1100 mm. The experimental soil was Godavari deltaic alluvium-derived Vertisol, slightly alkaline (pH 7.71), low in electrical conductivity (0.32 dS/m), available N (231 kg/ha) and organic carbon (0.40 %) and high available phosphorus (36.0 kg/ha) and potassium (416 kg/ha). The treatments for the field experiment included fallow-tobacco, foxtail millet-tobacco, finger millet-tobacco, turmeric and chilli crops/cropping systems are arranged in randomized block design with 4 replications throughout. The recommended seed rate, spacing, fertilizers and all other agronomic interventions were applied to raise these crops. The grain yields of *kharif* crops foxtail millet, finger millet, chilli and turmeric were converted into tobacco leaf equivalent yield (TLEY) based on prevailing market prices. System productivity was worked out by adding tobacco leaf equivalent yield of *kharif* season crops to their respective *rabi* crop component. Land use efficiency (LUE) was calculated with the formulae LUE (%) = TND (i) /365 100, where TND (i) is total number of days (TND) field remained occupied under different crops in a system (i=1…n). Relative production efficiency (RPE) was calculated by formulae RPE (%) = (EYD-EYE)/EYE 100, where, EYD = equivalent yield under improved/diversified system, EYE = equivalent yield under existing system. Relative economic efficiency (REE) was calculated by formulae REE (%) = (DNR-ENR)/ENR 100, where, DNR = net returns obtained under improved/diversified system, ENR = net returns in the existing system.

RESULTS AND DISCUSSION

Among the crops and cropping systems studied, system productivity based on tobacco leaf equivalent yield (TLEY) was higher in chilli (2588 kg/ha), being 56.4%, 38.5%, 37.0% and 2.5% more than fallow-tobacco, ragi-tobacco, korra-tobacco and turmeric crops/cropping systems respectively (Table 1). Higher yield and better price prevailed in market played major role in improving the tobacco leaf equivalent yield of chilli. The next best crop in the order is turmeric with TLEY of about 2531 kg/ha, it can also attributed mainly due to higher productivity of turmeric crop besides good market price. However TLEY of turmeric was statistically on par with chilli. Highest gross returns (323467/ha and 316404/ha) and net returns (1,53,467/ha and 136404/ha) were recorded under chilli and followed by turmeric respectively compared to korra-tobacco, ragi tobacco and fallow-tobacco (Table 1). Benefit cost ratio values have not shown any significant difference between the crops and cropping systems studied. Highest system productivity based on TLEY recorded in chilli and turmeric crop, which is due to high productivity levels of chilli and

Table 1: System productivity based on TLEY, gross returns, net returns and benefit cost ratio as influenced by crop intensification and diversification

Treatments	System productivity (kg/ha)	Gross returns (Rs./ha)	Net returns (Rs. /ha)	Benefit cost ratio
Fallow-Tobacco	1665	208123	92823	0.81
Foxtail millet-Tobacco	1888	236033	103233	0.78
Finger millet-Tobacco	1869	233629	97329	0.71
Turmeric	2531	316404	136404	0.76
Chilli	2588	323467	153467	0.90
SEm±	90	11237	11237	NS
CD (P=0.05)	277	34623	34623	NS

turmeric coupled with more price prevailed in the market for chilli and turmeric.

Chilli and turmeric recorded significantly highest relative production efficiency (55% and 52% respectively) and relative economic efficiency (65% and 46% respectively) over the existing fallow tobacco system (Fig.1). Highest land use efficiency values were recorded under finger millet- tobacco (67%), turmeric (64%), foxtail millet-tobacco (61%) and chilli (58%) compared to fallow-tobacco system (37%). Earlier studies also reported that, mono-cropping of crops other than tobacco are not remunerative as that of tobacco based on the prices prevailed in the market. However, cropping systems are remunerative compared to fallow-tobacco system (Kasturi Krishna et al., 2007 and Kiran Kumar et al., 2020).

it is concluded that based on the study, it is concluded that sole crop chilli followed by sole crop turmeric were found to be highly productive and profitable and efficient in utilization of existing resources and enhanced the farm income in FCV tobacco growing black soil region of Andhra Pradesh.

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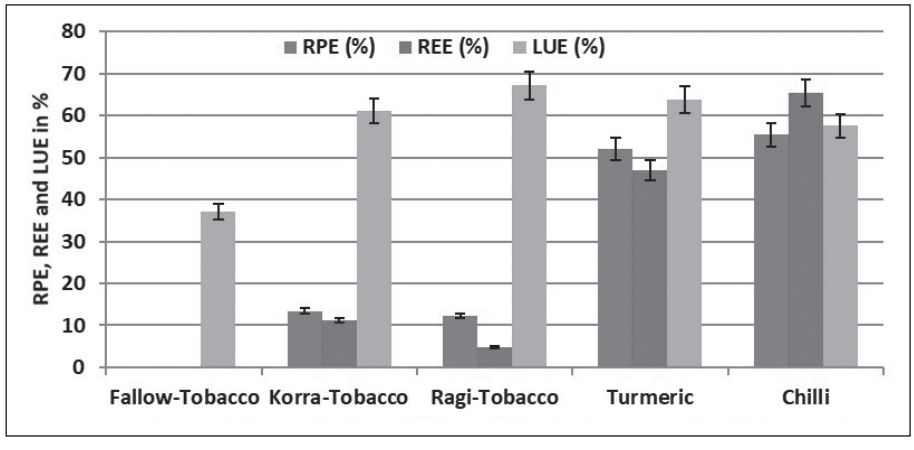

Fig. 1: Relative production efficiency (%), Relative economic efficiency and Land use efficiency (%) influenced by crop diversification and intensification