

Alternate crops

for risk minimization in rainfed agriculture

B Sahadeva Reddy*, A Mallishwar Reddy, S M Kurmvanshi, C K Arya, R S Raut, Diana Shamuralitpam and B Bhargavi

All India Coordinated Research Project for Dryland Agriculture Centre, Ananthapuramu, Andhra Pradesh 515 001

Climate change, aberrant south-west monsoon behaviour, frequent droughts, excess rainfall events, multiple soil nutrient deficiencies and poor socio-economic settings are the principle constraints for low and unstable yields in rainfed areas. Aligning crop choices coping with weather aberrations, matching resource endowments and market demand are the key factors that help in risk minimization and enhance production, productivity and profitability of the rainfed farmers. The network centres of All India Coordinated Research Project for Dryland Agriculture (AICRPDA) identified and demonstrated agroecology specific alternate crops. These crops at Ananthapuramu and Ballawal Saunkhri region not only increased the productivity and profitability, but also helped to manage weather aberrations and minimized risk.

Keywords: Alternate crops, Rainfed agriculture, Risk minimization

IN India, the south-west monsoon is accountable for more than three-fourth of the nation's total annual precipitation and has a strong influence on the rainfed agricultural production system. At present, in India, about 52% of the net sown area is rainfed, contributing 40% of the total food production and supporting 40% human and 60% livestock population. Climate change, aberrant behavior of monsoon rainfall, land/soil degradation with multiple nutrient and water deficiencies, declining ground water table and poor resource base of the farmers are regarded as the principle constraints for low and unstable yields in rainfed areas. Due to the diverse agro-ecologies in rainfed areas, a plethora of crops and mixed cropping systems are cultivated in the country. Crop substitution or diversification is typically viewed as a transition from historically grown less remunerative and high risk crops to more remunerative and risk resilient crops. The crop shift also takes place due to land use change, governmental policies and thrust on some crops over a stipulated time. Higher profitability and also the resilience/stability in production induce crop diversification/substitution. The alternate crops can expand and improve crop production of various rainfed crops and also minimizes the risk in rainfed agroecologies.

Climate resilient crops

Higher yields can be attained by sowing suitable

crops at the right time and with the right land use conditions. The choice of crops and varieties is more relevant under highly complex rainfed production systems and areas frequented with weather vagaries. As a general rule, rainfed crops are sown early with the onset of monsoon to realize higher yields. However, any delay in monsoon beyond normal period affects the sowing of crops of longer duration or narrow sowing window. The crops with wider sowing windows can still be taken up during the season without major yield loss by using short duration cultivars. Beyond the sowing window, choice of alternate crops or cultivars depends on the farming situation, soil, rainfall and cropping pattern in the location and extent of delay in the onset of monsoon. For example, pulses and oilseeds are preferred over cereals due to less water requirement and hence can be grown under delayed *kharif* sowing. Further, cluster bean, moth bean and horsegram are suitable for low rainfall areas. During winter (*rabi*) season, under residual soil moisture, chickpea and lentil are preferred over peas and french bean. Similarly, oilseed crops, viz. groundnut, castor, sesame and niger perform well under rainfed conditions during rainy (*kharif*) season. In the rapeseed-mustard group of crops, taramira is the best choice for light textured soil with low moisture storage capacity, followed by Indian mustard. Among the *kharif* cereals, coarse cereals-millet, ragi and sorghum are better choice over maize and

rice. Similarly, in *rabi* season, barley does well under conserved soil moisture than wheat. Among the millets, setaria is the most suitable crop for late sown condition without affecting the productivity.

Alternate crops to groundnut in arid alfisols of scarce rainfall zone of Andhra Pradesh

Monocropping of groundnut is the predominant cropping system in Rayalaseema region of Andhra Pradesh. Ananthapuramu district is the largest groundnut growing district in the world, with a cultivable area of 5.0–8.5 lakh ha every year and comprises 90% of the cultivated area under rainfed condition. Groundnut is recommended to be grown during June–July in Ananthapuramu district. However, due to abiotic stresses like frequent droughts and wet spells occurring at different phenophases of the crop and also other biotic stresses (wild boar attack, red hairy caterpillar, leaf miner, PSND, stem rot, late leaf spot and rust), affects the crops. The groundnut crop yields are not only low but unstable. In recent years, the groundnut pod yields have reduced drastically.

There are incidences of complete crop failure due to severe drought or wet spells. In addition, the increased cost of groundnut cultivation, i.e. around ₹75000/ha is associated with a high risk of crop failure leading to huge monetary losses to groundnut growers. Under these conditions, there is a need for alternate crop to groundnut to realize stable yields under rainfed situations. A 6-year long field experiment was conducted at AICRPDA centre, Ananthapuramu on



Castor as an alternate crop

various alternate crops to groundnut in Alfisols, viz. castor, sorghum, pearl millet, foxtail millet, pigeonpea, green gram, cluster bean, field bean and cowpea, sown at different sowing times (first and second fortnights of June and July and first fortnight of August) revealed that castor and pigeonpea performed better in terms of economic yield (groundnut equivalent), monetary returns and rainwater use efficiency next to groundnut.

Interestingly, growing of castor (a low water requirement crop), assuring high yields with relatively less cost of cultivation (₹25000/ha) and can be an alternative to groundnut. In addition, unlike groundnut cultivation, wild boar menace is not an issue with castor production. Due to higher net returns than groundnut,



Sorghum, horsegram, cowpea and pearl millet as alternate crops

pigeonpea cultivation has recently increased under rainfed cultivation. Castor and red gram, which can be grown from June–July, are thus suggested as alternatives to groundnut. In order to achieve the best results, contingent crops like sorghum, horsegram, cowpea, and pearl millet can be grown after July in the scarcity zone of Andhra Pradesh.

Alternate crops to vertisols of scarce rainfall zone of Andhra Pradesh

Due to continuous monocropping of chickpea in scarce rainfall zone of Andhra Pradesh, there has been a buildup of pests like boll worm and diseases like wilt and root rots. These biotic stresses reduce chickpea yield considerably, if proper crop rotation and management techniques are not followed. Several field demonstrations with safflower variety ISF-764 in shallow to medium deep black soils revealed that the yield of safflower (1050 kg/ha). The crop was suitable for mechanical harvesting thereby, reducing the cost of cultivation and thus, acted as an alternative to chickpea of Ananthapuramu region. Also, it was noticed that the safflower was more tolerant to terminal heat and moisture stress compared to chickpea. The farmer's feedback was that the safflower crop was more lucrative and freer from wild animals menace, pests, and diseases. The area under safflower in Ananthapuramu district increased significantly from 111–518 ha. Thus, safflower could be an alternate, remunerative and risk resilient crop to chickpea (Table 1).

Blackgram and mustard can be successfully grown as alternative crops to discourage the monocropping of chickpea, preventing the buildup of pests and diseases, and achieving the sustainable production system in vertisols of Andhra Pradesh. These crops were found to be profitable among the various crops evaluated in deep black soils.



Mechanical harvesting of safflower

Sesamum, ashgourd and taramira as an alternate crop to maize in Kandi region of Punjab

Maize is the main *kharif* season crop in Kandi area of Punjab. The crop encounters in season drought result in non-economical yields and the crop damage due to wild and stray animals in the area acts as a major constraint in maize cultivation. Due to these problems, farmers in the recent years are not interested to grow maize and keep their land fallow. Sesame is an alternative crop for maize in *kharif* season as well as during the delayed onset of the south-western monsoon. Also, it comes up well in well-drained sandy loam soil. Sesame is a drought-tolerant crop that requires less water and has lower cultivation costs than maize. Sesame can be grown in areas where stray or wild cattle are a threat, since it is least damaged by wildlife. Sesame variety, Punjab Til 2 was found suitable under delayed onset of monsoon condition during *kharif* with an average yield of 450 kg/ha and net returns of ₹34,000/ha. Under rainfed conditions, the

Table 1. Alternate crops and intercropping systems to cope with delayed onset of monsoon

Agrclimatic zone/State/ AICRPDA centre	Major rainfed production systems/ crops	Suggested crops/intercropping systems with delay in onset of monsoon		
		4 weeks	6 weeks	8 weeks
Western Plateau zone/ Jharkhand/Chainki	Rice	--	Pigeonpea + sorghum/okra	Cowpea/niger/ vegetable pea, mustard
Eastern Plain zone/Uttar Pradesh/Faizabad	Rice	Maize + cowpea, Maize + pigeonpea	Maize + cowpea, maize + pigeonpea	Blackgram
Bastar Plateau zone	Rice	Finger millet Little millet	--	Early <i>rabi</i> pulses like blackgram
Eastern Plain and Vindhyan zone of Uttar Pradesh/Varanasi	Rice	Greengram/blackgram/sesame/ pearlmillet	Pigeonpea + sesame/greengram	Replace rice with pearlmillet for fodder purpose, pigeonpea + pearlmillet
Northern dry zone/ Karnataka/Vijayapura	<i>Rabi</i> Sorghum	Pigeonpea, castor, mothbea and cowpea; pigeonpea + blackgram	Pearlmillet, castor, cowpea, setaria, sorghum fodder Pearlmillet + pigeonpea (2:1);	Sunflower, castor, cowpea, chickpea + safflower, <i>rabi</i> sorghum + chickpea
Scarcity zone/ Maharashtra/Solapur	<i>Rabi</i> Sorghum	Pigeonpea, castor, mothbean, horsegram, cowpea	Pearlmillet, castor, setaria spp., cowpea, sorghum (fodder); Intercropping of pigeonpea + clusterbean (1:2), castor + pigeonpea (1:2), pigeonpea + coriander (1:2)	Sunflower, pigeonpea, greengram, blackgram, castor, pearlmillet, cowpea

Agrclimatic zone/State/ AICRPDA centre	Major rainfed production systems/ crops	Suggested crops/intercropping systems with delay in onset of monsoon		
		4 weeks	6 weeks	8 weeks
Southern zone/ Rajasthan/Arjia	Maize	Maize fodder, Sorghum (fodder), greengram, blackgram, horsegram	Sorghum (fodder), Pearlmillet (fodder), Horsegram	--
Subtropical zone, Jammu/Rakh Dhainsar	Maize	Maize fodder, pearlmillet, sesame, sorghum fodder, Intercropping of Pearlmillet + cowpea/blackgram/greengram (1:1)	Maize (fodder), intercropping of pearlmillet + cowpea (1:1), maize (fodder) + cowpea (1:1) for fodder purpose, Intercropping of sorghum (fodder) + cowpea (1:1) for fodder purpose	Intercropping of maize/ sorghum/ pearlmillet + cowpea (for fodder), Sorghum/pearlmillet + cowpea
South-west semi-arid zone/Uttar Pradesh/ Agra	Pearlmillet	Clusterbean, greengram, blackgram	Pearlmillet for fodder purpose, greengram, blackgram,	--
Northern Gujarat/ S.K.Nagar	Pearlmillet	Blackgram, groundnut, sesame, clusterbean, castor + greengram, castor + cowpea, mothbean	Blackgram, pigeonpea, cluster bean, fodder sorghum, castor, fennel	Blackgram, pigeonpea, fodder sorghum, castor, fennel
Eastern and Southern Dry zones/Karnataka/ Bengaluru	Finger millet	Finger millet + pigeonpea (8:2); finger millet + field bean (4:1); Finger millet + niger, groundnut, pigeonpea, cowpea, maize + pigeonpea (3:1)	Little millet, foxtail millet, inter- cropping of maize+cowpea/ blackgram/greengram/field bean.	Little millet, foxtail millet, cowpea, sunflower, field bean
North Saurashtra/ Gujarat/Rajkot	Groundnut	Castor, sorghum, greengram, blackgram, sesame	Greengram, castor, sorghum, sesame, pigeonpea	Sesame, castor, sorghum, greengram, blackgram, pearlmillet
Malwa Plateau zone/ Madhya Pradesh/Indore	Soybean	Maize fodder, pigeonpea + soybean, sunflower + pigeonpea, blackgram, greengram + sunflower sesame,	Sunflower, maize for fodder	Maize fodder
Kymore Plateau and Satpura Hill zone/ Madhya Pradesh/Rewa	Soybean	Pigeonpea, greengram, blackgram	Sesame, blackgram, greengram	Greengram, blackgram
Western Vidarbha zone/ Maharashtra/Akola	Cotton	Replace sorghum, greengram and blackgram by soybean or pigeonpea	Sunflower, pearlmillet, sesame, castor and pearlmillet + pigeonpea (2:1 or 4:2)	Sunflower, sesame, pearlmillet, pigeonpea, greengram, blackgram
Central Maharashtra zone/Parbhani	Cotton	Greengram, blackgram, sorghum, pearlmillet, pigeonpea	Sesame, castor, greengram, blackgram, sorghum, pearlmillet, pigeonpea	Sesame, castor, greengram, blackgram, sorghum

ashgourd also gave an average fruit yield of 35.5 t/ha with a net return of ₹65,625/ha. Further, it was observed that the crop damage due to wild and stray animals in ashgourd was minimum as compared to maize. During *rabi*, farmers in the region generally grew local taramira cultivars as a guard crop around wheat or as mixed crop with pulses in upper Kandi and also as sole/intercrop in lower Kandi region. Since, its crop leaves are bitter in taste with pungent smell, they avert the wild animals from crop damage. In view of the severe wild animal menace in Kandi region, growing of taramira cv. TMLC in time enabled farmers to take up successful *rabi* cropping and recorded a seed yield of 762 kg/ha with net return of ₹13,500/ha and B:C ratio of 3.39.

The onset of monsoon is critical for taking up timely sowing of normal crops during *kharif* in rainfed areas. If the onset is delayed beyond 4 weeks, accordingly, the farmer has to select alternate crops to avoid fallowing during *kharif*, to produce for his domestic needs and income, though sometimes yield levels are not so high. The network centres of AICRPDA, over a period of research developed various alternate crop/cropping strategies for scaling out in various core rainfed

agroclimatic zones (Table 1).

SUMMARY

In rainfed areas, crop production is limited by many abiotic and biotic stresses. The selection of crops depends upon the farmer's traditional knowledge, resource availability, socio-economic factors and market forces. The selection of the crops should also be made to cope with weather aberrations such as delayed onset of monsoon and other extreme weather events. The challenge is to sensitize the farmers about alternate crops through large scale demonstrations to arrange availability of the seed, other recommended inputs, capacity building about the package of practices of these crops, and mechanization through custom hiring centres. Concerted efforts are needed by government and other agencies for all these activities. Further, convergence of programmes/schemes of national and state governments are needed for scaling out alternate crops/cropping systems for achieving risk resilient and sustainable rainfed agriculture.

*Corresponding author's e-mail: b.sahadevareddy@angrau.ac.in