 DOI:10.5958/j.0976-4038.5.1.027

Upscaling and Outsclaing of *Rabi* Castor in Andhra Pradesh- Opportunities and Limitations

A. V. Ramanjaneyulu[1*], K. Dharma Reddy[1], A. Vishnuvardhan Reddy[1], M. V. Nagesh Kumar[1], S. Khayum Ahammed[1], V. Gouri Shankar[1] and T. L. Neelima[2]

[1]Regional Agricultural Research Station,[2]Agricultural Polytechnic, ANGRAU, Palem, Mahabubnagar district, Andhra Pradesh (509 215), India

Article History

Manuscript No. cn545
Received in 8th March, 2013
Received in revised form 14th November, 2013
Accepted in final form 5th March, 2014

Correspondence to

E-mail: avr_agron@rediffmail.com

Keywords

Botrytis disease, outscaling, *rabi* castor, upscaling

Abstract

Castor has been a traditional oilseed crop grown under rainfed conditions in an area of 0.35 m ha in Andhra Pradesh. However, these days, most of the dry land farmers in Andhra Pradesh are shifting from castor to Bt cotton and maize during *kharif* season because of less yield and remunerative returns from castor. It was mainly due to drought, botrytis disease, poor adoption of agronomic and plant protection measures besides non-availability of good quality seeds of castor. As castor is an important industrial oilseed crop fetching more than ₹ 2500 crores of foreign exchange, researchers felt that it is essential to increase the productivity of castor by promoting its' cultivation in *rabi* season as crop will be free from botrytis grey rot disease and crop can be grown with less water. The research and on-farm demonstrations carried out in Andhra Pradesh proved that, *rabi* castor is more remunerative than *kharif* castor and *rabi* groundnut. This paper describes the agrotechniques developed at research station level and the way *rabi* castor was promoted among the farmers in Andhra Pradesh through upscaling and outscaling extension strategy.

1. Introduction

Castor is an important non-edible and commercial oilseed crop grown. It is the second most important oilseed crop next to groundnut in terms of acreage and economy in the state. Earlier, the crop was mostly restricted to Southern Telangana agro-climatic zone of the state covering Mahaboobnagar, Rangareddy and Nalgonda districts.

The productivity of castor during *kharif* season in the state is low and varies from 500-675 kg ha^{-1} depending on rainfall pattern (Table 1). It is far below than that of Gujarat (1978 kg ha^{-1}), Haryana (1600 kg ha^{-1}), Rajastan (1417 kg ha^{-1}) and national average (1512 kg ha^{-1}) (DOR, 2012). This is mainly owing to the following reasons. The soils of castor growing areas in A.P. fall under Alfisols which are characterized by poor texture, shallow depth, less water holding capacity and low fertility. Traditionally, farmers have been growing castor as a rainfed crop during *kharif* season depending on the showers from South West Monsoon (SWM). The crop in this season often experiences long dry spell mainly during mid or terminal stages of its' growth. The cyclonic rains coupled with high relative humidity (>90%) during spike formation/development stage results in severe incidence of *Botrytis* grey rot (*Botrytis ricini*). Unfortunately, neither resistant varieties nor effective control measures are available against this dreaded disease. Besides, non-availability of good quality seed, meager water resources, poor adoption of agronomic and plant protection measures are other reasons for low productivity. On the otherhand, the castor crop is grown in fertile soils, under either conventional or drip irrigation methods in the states of Gujarat, Rajasthan and Haryana.

Keeping in view the wide array of industrial uses of castor and its' by products, enhancing the productivity of castor seems to be essential. Growing castor as an ID (irrigable dry) crop under irrigated conditions is a new dimension. This is because, moisture stress and incidence of botrytis are altogether avoided during *rabi* season (Ramanjaneyulu et al., 2011). Further, productivity can be enhanced to 25-30 q ha^{-1}.

2. Materials and Methods

The scientists of RARS (ANGRAU), Palem, Andhra Pradesh, India have developed suitable agro-techniques for *rabi* castor by conducting research to identify the optimum date of sowing, irrigation scheduling, response of hybrids/varieties to N levels, suitable short duration and remunerative preceding crops and drip fertigation requirements. Seed production of

newly released hybrids/varieties was also taken up on a large scale in order to ensure supply of good quality seed. Nearly 250 t of good quality seeds of the cultivars like PCH-111, PCH-222, Kranti and Haritha was produced through farmer participatory approach under ICAR and 100% SRR schemes and the same was sold out to the needy farmers. Further, 200 front line demonstrations were conducted in different districts such as Mahabubnagar, Warangal, Ranga Reddy, Kurnool, Anantapuram of Andhra Pradesh. The farmers were selected from different villages and inputs like seeds, fertilizers and need based plant protection chemicals were distributed. A team of scientists including Agronomist, Breeder, Entomologist and Plant Pathologist have visited and monitored the demonstration sites at an interval of 15-20 days during the crop growing period. Finally information on seed yield, cost of cultivation and returns was collected after harvesting and marketing of the produce. Field days were organized at the demonstration in different villages with a view to transfer the technology to a large group of farmers across the state. Besides, pamphlets and brochures were printed in vernacular languages and distributed to the farmers in the field days and also to those who visit the research station before commencement of crop season. Information on *rabi* castor technology was disseminated regularly through print and electronic media and mass communication tools.

3. Results and Discussion

Scientists of Regional Agricultural Research Station (RARS), Palem, Acharya N.G. Ranga Agricultural University have developed following agrotechniques and encouraged farmers to adopt the same for reaping higher yields from *rabi* castor.

3.1. Agrotechniques developed

• Greengram or maize has to be grown during first or second week of June as a preceding *kharif* crop to *rabi* castor

• For *rabi* castor, a spacing of 90-120×60 cm is to be followed depending on soil type under conventional method of irrigation. While under drip irrigation, lateral to lateral spacing of 120-150 cm and dripper to dripper spacing of 40-60 cm. Row to row and plant to plant spacing of 120-150 cm and 60-90 cm, respectively is to be adopted.

• Sowing around 1st Oct was found to be optimum. It was observed that, with delay in sowing from Oct 1 to Oct 15 (15 days), Nov 1 (30 days) and Nov 15 (45 days), bean yield of castor declined by 21.5%, 24.1% and 44.1%, respectively (Ramanjaneyulu et al., 2010).

• Irrigation has to be scheduled at 50 to 75 mm CPE under conventional method of irrigation for higher yield and water use efficiency (Ramanjaneyulu et al., 2010; Reddy et al., 2006), While under drip method, irrigation has to scheduled at 60% of pan evaporation at three days interval. Nearly 30.0% water can be saved through adoption of drip irrigation.

• A fertilizer dose of 80:40:30 kg N, P_2O_5 and K_2O ha^{-1} is needed. Half the dose of N, full dose of phosphorus and potash are to be applied as basal. Remaining dose of N has to applied in three equal splits as top dressing at 30, 60 and 90 DAS (days after sowing) through pocketing method**.** While for the drip fertigation, full recommended dose of phosphorus (40 kg P_2O_5 ha^{-1}) and potash (30 kg K_2O ha^{-1}) have to be supplied through SSP (single super phosphate) and MOP (muriate of potash), respectively. On the other hand, N at the rate of 120 kg ha^{-1} has to be supplied through urea, in 20 split doses starting from 10 days after sowing (Ramanjaneyulu et al., 2012).

• Pre-emergence application of Pendimethalin @ 1.0 kg a.i. ha^{-1} followed by 2-3 times intercultural operation depending on weed menace is advocated for effective weed control during critical period of crop weed competition (45-60 DAS).

• Sucking pests are the main problem in *rabi* castor, which can be effectively controlled by spraying Monocrotophos (2 ml l^{-1})/ Dimethoate (2 ml l^{-1})/Acephate (1.5 g l^{-1}). *Spodoptera* which skeletonises the leaves and affects the photosynthetic process, can be brought under control by spraying Chloripyriphos (2.5 ml l^{-1}). In advanced stage, the large sized larvae can be controlled by poison bait. It is prepared by mixing 1.25 litres of monocrotophos/ chloripyriphos or 1.25 kg of Carbaryl with 12.5 kg of rice bran and 1.25 kg of Jaggery and this mixture is sufficient for one ha area. It should be made into small round balls and left in the field at random, during late evenings between furrows. Erecting bird perches @ 25-30 ha^{-1} will help

Table 1: Area, production and productivity trends of castor in Andhra Pradesh

Year	Area (mha)	Production (mt)	Productivity (kg ha^{-1})
1997-98	0.171	0.047	275
1998-99	0.204	0.045	221
1999-00	0.264	0.059	223
2000-01	0.392	0.131	333
2001-02	0.284	0.083	293
2002-03	0.232	0.086	375
2003-04	0.291	0.132	453
2004-05	0.271	0.105	388
2005-06	0.345	0.140	407
2006-07	0.202	0.087	430
2007-08	0.199	0.129	654
2008-09	0.159	0.081	511
2009-10	0.147	0.085	442
2010-11	0.186	0.120	645
2011-12	0.230	0.156	677

in biological control of the above larvae. The menace of castor shoot and capsule borer which damages developing capsules, can be reduced by spraying Acephate (1.5 g l^{-1})/Novoluron (1.0 ml l^{-1}).

• Wilt can be controlled through the selection of resistant varieties (Haritha and 48-1) and hybrids (PCH-111, PCH-222, DCH-177 and DCH-519) or seed treatment with Carbendazim (3 g kg^{-1})/*Trichoderma viridae* (10 g kg^{-1}) or drenching the soil around the base of plant with Carbendazim (3 g kg^{-1}).

• Harvesting has to be done when >60-70% of capsules on the spike turn from green to brown. If harvesting is done with the help of hand secatures, damage to palms to can be avoided besides reducing the loss of capsules. The spikes have to be dried for one week under sun light and then will be threshed by using castor threshers.

• Castor seed yield of 25-30 q ha^{-1} can be obtained under conventional irrigation system while through drip fertigation, 35-38 q ha^{-1} can be realized. It means, >50% enhancement in yield can be expected under drip fertigation (Ramanjaneyulu et al., 2012).

The above technology has been transferred to the castor growers of the state through orientation classes before sowing, organizing front line demonstrations (Table 2), field inspections during crop growth period, conduction of field days (Table 3) at fully formed primary spike stage, printing and distribution of extension folders/pamphlets/popular articles (Table 4).

3.2. Training cum field days organized

200 FLDs were conducted and 6 field days and one exposure visit were organized to promote *rabi* castor under conventional and drip irrigation methods.

During *rabi* season, groundnut occupies maximum area (0.12 m ha) among ID crops in Mahabubnagar district. While *rabi* castor is just introduced. Hence, castor was compared with groundnut during *rabi* season while conducting front line demonstrations. Results of the front line demonstrations presented in Table 5 revealed that castor during *rabi* season is profitable than *kharif* castor (sole) or castor+pigeonpea (4:1) intercropping system. It is because, net returns (₹ 8491 to 25969 ha^{-1}) and benefit:cost ratio (2.3 to 2.7) were higher from *rabi* castor than *rabi* groundnut (b:c ratio: 1.5 to 2.1) and *kharif* castor/castor+pigeonpea intercropping (₹ 1848 to ₹ 12713 ha^{-1}; 0.5 to 2.2). These results were earlier confirmed by Ramanjaneyulu and Vishnuvardhan Reddy (2008 & 2009).

3.3. Up-scaling/outscaling

Up-scaling is a vertical expansion/acceptance of an approach or model and it involves continuous upgradation of an approach and building a constituency for the same among other

Table 2: Frontline demonstrations conducted

Year	Conducted	Major impact of FLD in the region
2007-08	30	Many farmers in Mahabubnagar, Ranga Reddy, Kurnool and Anantapur districts accepted *rabi* castor in view of remunerative returns and less water requirement besides no botrytis incidence. Of course, wild boar menace is totally absent on castor.
2008-09	50	
2009-10	30	
2010-11	40	
2011-12	50	
Total	200	

Table 3: List of field days organized to popularize *rabi* castor in Andhra Pradesh

Date	Venue of the field day conducted	Purpose	No. of beneficiaries
29th Jan, 2008	RARS, Palem Mahabubnnagar dist	To popularize *rabi* castor and PCH-111 hybrid of castor along with matching production technologies	86
02nd Mar, 2009	Vittalapuram village Maldakal mandal Mahabubnnagar dist.	To popularize *rabi* castor and PCH -111 hybrid of castor along with good agronomic practices	102
23rd Feb, 2010	Machanpally Mahaboobnagar Dist.	To popularize *rabi* castor and PCH -111 hybrid of castor along with matching production technologies	100
12th Jan, 2011	RARS, Palem, Mahabubnnagar dist.	To popularize *rabi* castor under drip irrigation along with matching production technologies	175
11th Feb, 2011	Godal village, Balmoor mandal, Mahabubnnagar dist.	To popularize *rabi* castor and PCH -111 hybrid of castor along with efficient irrigation methods	120
17th Jan, 2012	Jinnaram village, Narva mandal, Mahabubnnagar dist.	To popularize *rabi* castor under drip irrigation and promote PCH -111 hybrid of castor	200
13th April, 2012	A farmers' exposure visit was arranged in co-ordination with Department of Agriculture on to Vasanthapur village, Bijnapally mandal	*Rabi* castor hybrid seed production under drip irrigation	50

stakeholders including management and policy. Up-scaling is more often to connote spreading/diffusion of a model/ technology across large area. In the case of outscaling, typically the same approach in other institutions or other district/state is replicated. It is horizontal scaling out of the same approach in other locations.

Now-a-days, the castor crop is spreading to non-traditional areas like Anantapur, Kurnool, Kadapa and Prakasam districts as an alternate crop to traditionally grown groundnut crop due to availability of good quality seed of wilt resistant and high yielding castor hybrids like PCH-111 and PCH-222 along with matching crop production technologies and better market price. Besides, castor is not eaten by wild boar which otherwise is a menace in groundnut, maize, sorghum and other food crops.

Table 4: List of amphlets/extension folders/popular articles published

S. No.	Name of the pamphlet
1.	*Rabi* castor under drip irrigation- Management techniques
2.	*Rabi* castor cultivation- profitable
3.	Castor as an ID crop in *rabi*-profitable
4.	Drip irrigation for improving the yield and water saving in *rabi* castor

Thus, the area under castor cultivation increased tremendously from 0.199 mha (2007-08) to 0.345 mha (2011-12). At the same time, the productivity of castor increased from 511 kg ha^{-1} (2008-09) to 677 kg ha^{-1} (2011-12) as detailed in Table 1.

4. SWOT (Strengths, Weakness, Opportunities and Threats) Analysis

4.1. Strengths

- No botrytis in *rabi* season
- No wild boar menace on castor
- Availability of high yielding and wilt resistant hybrids (PCH-111, PCH-222, DCH 177 and DCH 519)/varieties (Haritha and 48-1)
- Seed production of hybrids/varieties on a large scale
- Availability of drip facility and subsidy for the same by the government
- Presence of RARS, Palem, District Agricultural Advisory and Technology Transfer Center (DAATTC), Mahabunagar and DOR, Hyderabad for technology development and transfer
- Availability of recommendations in respect of agronomic, entomological and pathological packages developed by RARS, Palem (Acharya N.G. Ranga Agricultural University) and Directorate of Oilseeds Research (DOR), Hyderabad

Table 5: Results of FLDs conducted to popularize *rabi* castor in Andhra Pradesh

Particulars	Seed yield (kg ha^{-1})		% increase in yield	Gross returns (₹ ha^{-1})		Additional net returns (₹ ha^{-1})	B:C ratio	
	IT	FP		IT	FP		IT	FP
			2007-08					
DCH-177/GCH-4*	1500	1217	23	27000	21900	4792	1.7	1.2
GCH-4/Haritha*	1100	800	38	19800	14400	4796	1.1	0.7
GCH-4/DCS-9*	1300	1000	30	23400	18000	4124	1.2	0.9
CR+PP/CA (4:1)*	1173	932	26	21172	16728	4456	1.4	0.9
			2008-09					
CR+PP (4:1)/CA*	1296	863	50	35687	22425	12713	2.1	1.0
CR+PP (4:1)/FP*	1374	1212	13	35520	31510	3866	2.2	1.8
PCH-111**	2827	2309	22	70685	63089	8491	2.6	2.1
			2009-10					
DCH-177*	898	798	13	20495	19180	1848	0.7	0.6
Haritha*	1113	833	34	25588	19167	5540	1.3	0.8
CR+PP (4:1)/CA*	1311	750	75	30125	15333	12449	1.0	0.2
PCH-111**	2911	2821	3.0	87330	85357	5545	2.3	1.9
			2010-11					
PCH-111*	750	625	20	30000	25000	5875	0.6	0.3
CR+PP (4:1)/CA*	789	500	58	31571	20000	10041	0.5	0.0
PCH-111**	2293	1951	18	100982	82559	25969	2.7	1.5

CR: Castor; PP: Pigeonpea; CA: Castor alone; FP: Farmers practice; *FLDs were conducted during *kharif* season; **During *rabi* season, castor (PCH-111 hybrid) was irrigated and is compared with *rabi* groundnut (K-6 variety)

4.2. Weakness

- Fluctuating market price from year to year and no minimum support price for castor
- Limited water resources
- Competition for water among paddy, groundnut and castor crops in *rabi* season.
- Electricity problems
- Cultivation by resource-poor farmers under low input management.
- Poor soil fertility with low water holding capacity

4.3. Opportunities

- Industrially very important crop
- Large scale seed production of quality seed through public and private partnership
- Upcoming of lift irrigation projects may improve the water availability for *rabi* castor and so productivity of the crop can be increased by cultivation under good management practices.
- Less water requirement by the crop. Further, introduction of drip irrigation technology saves 30% water requirement
- Castor is the best alternative to other crops like groundnut and sunflower in terms of net returns
- Ericulture in which castor leaves (up to 30%) can fed to silkworms can be practiced by farmers without yield reduction with minimum profit of ₹ 5000 to 7500 ha^{-1}
- Wild boar doesn't feed on castor

4.3. Threats

- Increasing market price and availability of minimum support price (MSP) for groundnut while the market price is stagnant for castor since last 10 years
- Water and electricity problems
- Competition for water
- Menace of sucking pests, S*podoptera* and Capsule borer during *rabi* season

5. Conclusion

From the foregoing results and discussion, it can be concluded that *rabi* castor is more remunerative than *kharif* castor and *rabi* groundnut, and can be grown with less amount of water and risk. Further, the problems such as botrytis and moisture stress can be avoided in *rabi* season. However, stagnant market price remains a major threat for promoting *rabi* castor in Andhra Pradesh.

6. References

DOR, 2011-12. Annual Progress Report on Castor, Directorate of Oilseeds Research, Hyderabad, Andhra Pradesh, India.

Ramanjaneyulu, A.V., Ramprakash, T., Vishnuvardhan Reddy, A., 2010. Effect of sowing date and irrigation scheduling on yield and economics of *rabi* castor in Southern Telangana Zone of Andhra Pradesh. Journal of Oilseeds Research 27 (Special issue), 180-181.

Ramanjaneyulu, A.V., Vishnuvardhan Reddy, A., 2009. Transfer of technology through farmer participatory research approach in Castor. Journal of Oilseeds Research 26 (Special issue), 306-308.

Ramanjaneyulu, A.V., Vishnuvardhan Reddy, A., Dharma Reddy, K., 2011. Castor as an ID crop during *rabi* season. Vyavasayam (Nov), 6-8.

Ramanjaneyulu, A.V., Vishnuvardhan Reddy, A., 2009. *Rabi* castor cultivation is profitable. Vyavasayam (Nov), 16-17.

Ramanjaneyulu, A.V., Vishnuvardhan Reddy, A., 2008. Castor cultivation during *rabi* season is remunerative. Annadatha (Nov) 40(11), 4-15.

Ramanjaneyulu, A.V., Vishnuvardhan Reddy, A., Dharma Reddy, K., 2012. *Rabi* castor cultivation under drip irrigation-Research progress-Popularisation activites. Training manual on "Scaling up of water productivity in Agriculture for livelihoods through teaching cum demonstration-Training of farmers" organized during 31st March to 6th April, 2012, 44-45.

Reddy, A.P.K., Sambasiva Reddy, A., Padmabvathi, P., 2006. Effect of irrigation and integrated nutrient management on seed and oil yield of *rabi* castor. Journal of Oilseeds Research 23(2), 239-241.