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On-farm assessment of improved production technologies of seed spices Ajwain (*Trachyspermum ammi* L.) and Coriander (*Coriandrum sativum* L.) in Adilabad district of Telangana

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Abstract

The seed spices, Ajwain and Coriander can be grown on marginal soils as profitable winter season crops in Telangana State. They require less input and higher net returns than traditional rabi crops like chickpeas, maize, groundnut, sesamum, sunflower and safflower grown in the Adilabad district. The area under the seed spices is negligible and dependent on other states for consumption. On-farm trials (OFTs) were conducted with improved varieties of Ajwain (AA93) and Coriander (Suguna / LCC-236) to improve the yields and net returns to the farmers of Bela and Jainad clusters of the Adilabad district. These trials tested four interventions: improved varieties, seed treatment, recommended doses of fertilizers and need-based plant protection measures. In the Ajwain OFTs, the AA-93 variety coupled with an improved package of practices achieved 24.81% higher grain yield than farmer's practice with local varieties. Gap Analyses revealed a mean extension gap of 160 kg ha^{-1}, a technology gap of 241 kg ha^{-1}, and a mean technology index of 27.07%. With an additional investment of Rs. 2615 per ha, incorporating recommended nutrients, water management, plant protection measures, scientific monitoring, and other non-monetary factors, farmers realized an additional net return of Rs. 32,177 ha^{-1}, with 5.47 Benefit: Cost Ratio. In similar On-farm trials in Coriander with improved variety, the Suguna (LCC-236) variety 20.27% higher grain yield than the farmers' practice with local varieties. The study revealed that there was a mean extension gap of 181 kg ha^{-1} and, a technology gap of 300 kg ha^{-1} with a mean technology index of 25%. An additional investment of Rs. 2464 ha^{-1} coupled with a recommended dose of fertilisers need-based plant protection measures resulted in additional net returns of Rs. 28,976 ha^{-1} with 5.58 as the average Benefit: Cost ratio. The study indicated seed replacement rate (SRR) of seed spices is very negligible and hence it needs to be prioritised by producing and supplying high-quality seeds of improved seed spice varieties to reach farmers.

Keywords: Seed spices, grain yield, economics, gap analysis, extension gap, technology gap

Introduction

Annual crops, whose seeds are consumed as spices, *viz*., coriander, cumin, fenugreek, fennel, ajwain, dill, anise, nigella, caraway, celery, etc., are called seed spices. There are 17 types of seed spices, and among them, coriander, cumin, fenugreek, anise, and ajwain are widely used in everyday life. These seed spices impart a good taste and aroma to the food and contain many vitamins, minerals, antioxidants, and medicinal properties that are good for health. According to a survey jointly conducted by Professor Jayasankar Telangana State Agricultural University (PJTSAU) and the National Academy of Agricultural Research Management (NAARM), Rajendranagar, the average per capita consumption in Telangana state is 21g per day, 640g per month, or approximately 7.58 kg of spices consumed annually (Kumar *et al*. 2017) [8]. The annual consumption of spices required by the population of Telangana state is 2.31 lakh metric tons, with an estimated value of Rs.1451.00 crores. The seeds are used for spices and have an estimated value of Rs.200.00 crores. In the Telangana state, there was more surplus production of turmeric and dried chillies than required and due to non-cultivation of seed spices like coriander, cumin, fenugreek, aniseed, ajwain, etc., deficiency was observed and imported from other states like Gujarat and Rajasthan. Ajwain (*Trachyspermum ammi* L.,) and Coriander (*Coriandrum sativum L*.,), in the Telangana state, play a prominent role as winter season crops that can be grown on marginal soils as they require less inputs and higher returns. Despite, similar climatic conditions in Telangana state, the area under these seed spices is not very pronounced due to a lack of awareness among the farming community and improved seed supply. Therefore, keeping this in mind, we should encourage the cultivation of the seed spices in the Telangana

state, reduce the import from other states, provide high income to the farmers of Telangana state and quality products to the consumers.

Ajwain, also known as carom seed, is a dry-land crop that can be grown in Telangana with minimal inputs and water. It is mainly grown during the winter season, with sowings in September and October in the different parts of Telangana state. Ajwain is a key ingredient in Indian cooking to flavor meat, rice, soups, sauces, and curries made with chicken, fish, beans, or lentils. Ajwain seeds can help with digestion, relieve acidity, and alleviate bloating. It can also help with weight loss, fight bacteria and fungi, lower blood pressure, and improve respiratory conditions. Ajwain is rich in fibre, and its active enzymes help promote digestion by improving gastric juice secretion. Ajwain also contains thymol, which can help lower blood pressure by blocking calcium channels. Coriander is a versatile herb and seed spice widely recognized for its culinary applications. Coriander as a seed spice has bioactive compounds, essential oils, phenolic acids, and flavonoids, and its positive role in potential health benefits such as antimicrobial, antioxidant, anti-inflammatory, and hypoglycemic properties (Singh *et al*., 2006) [3].

The productivity of seed spices, ajwain, and coriander in the Adilabad district is very low, primarily due to the unavailability of suitable variety seeds and farmer's ignorance of improved production technologies, recommended doses of fertilizers, and plant protection measures. Crop improvement, production, and protection technologies had a strong impact on changing the overall seed spice production scenario in the Telangana State. A review of current farmer practices and improved production technologies to enhance the productivity of ajwain and coriander is presented in Table 1. With this background, an on-farm assessment of improved production technologies for ajwain and coriander was conducted during the winter season 2023–24.

Table 1: A comparative analysis of farmers' practices and improved production technologies for ajwain and coriander in Adilabad district.

Component	Farmers practices	Improved recommended production technologies	
		Ajwain	**Coriander**
Use of seed	Locally available seed	AA-93 (Ajwain) is an improved variety of Ajwain developed at NRCSS, Ajmer.	Suguna (LCC-236) as an improved variety of coriander released from the regional agricultural research station, lam, Guntur
Seed treatment	No seed treatment	Seed treatment with Trichoderma viridae @ 10 g kg^{-1} seed or 1 g Carbendazim	Seed should be treated with *Trichoderma viridae* @ 4.0-6.0 g kg^{-1} seed.
Sowing method	Broad casting	Line sowing and thinning to maintain optimal plant stand with spacing of 20 x 60 cm	Line sowing and thinning to maintain optimal plant stand with spacing of 10 X 30 cm
Recommended fertilizer	Application of DAP 50kg ha^{-1}	Application 40 kg N, 50 kg P_2O_5 and 50 kg K_2O ha^{-1}	Application of 30:40:20 kg NPK ha^{-1}
Plant protection	No plant protection measures were followed.	• Application of Neem oil 2% for sucking pest control. • Dusting with Sulphur (25 kg ha^{-1}) for control of powdery mildew disease.	• Application of Neem oil 2% for sucking pest control. • Spraying twice Mancozeb 3 g L^{-1} at the time of flowering and seed formation stage for control of grain mould

Materials and Methods

Horticultural Research Station (HRS), Adilabad, conducted an on-farm assessment of improved production technologies (OFTs) on seed spices under irrigated conditions using a cluster approach in Jainad and Bela mandals in Adilabad District during the winter season in 2023–24. We used the cluster approach as a means of promoting crop colonies to accelerate dissemination and effective monitoring. The baseline information of the selected villages was collected before conducting the cluster OFTs. Farmers were selected through focus group discussions, interaction meetings, awareness campaigns, and field trips. In Ajwain, 10 OFTs and in Coriander, 18 OFTs of 0.4 ha each were conducted in different farmer fields. To spread awareness of the technology among the local farmers, before the conduct of OFTs, extensive mass media coverage on "Profitable seed spice cultivation 'in Raithu Nestham, Door Darshan Yadagiri Television Channel, Kisanvani, AIR, FM Radio Station, Adilabad was organized. Extension literature was brought on seed spices production technology and conducted one day of farmers training with the support of scientists of Horticultural Research Station, subject matter experts of Krishi Vigyan Kendra (KVK) and officials from the Department of Horticulture with financial support from the Mission for Integrated Development of Horticulture (MIDH), New Delhi. A few critical inputs in the form of quality seed, balanced fertilizers, and agro-chemicals (Neem Oil) for plant protection measures were provided to the farmers in OFTs, and nonmonetary inputs like line sowing, timely weeding, and irrigation were advised to be performed by the farmers. Growing of locally available seed without seed treatment and application of 50 kg ha^{-1}DAP application with indiscriminate use of pesticides was prevailing in the area as farmers practice.

Improved Varieties

Ajwain variety AA-93 and Coriander Suguna (LCA- 236) seeds produced at HRS, Adilabad were used for conducting the on-farm trails. AA-93 is an open-pollinated variety developed through mass selection, with 50 per cent flowering only in 46 days after sowing irrespective of sowing dates and matures 30-40 days early in comparison to normal existing improved cultivars, which takes 150-170 days.

Coriander Suguna (LCA- 236) has a Medium duration variety with 90-95 days duration. Grain is slender, and oval-shaped. Yield potential is 750-1350 kg/ha is having high volatile oil (0.52%) content (Praveena *et.al* 2019) [4].

Ajwain and coriander seeds were sown between the third week of October and to first week of November 2023. All the participating farmers were trained on scientific aspects of ajwain and coriander production management before implementing the OFTs in their field.

Seed yield and input and output costs for OFTs and local practices commonly adopted by the farmers in the study villages were collected and evaluated. The yield data obtained in farmers' practices and improved package of practices, and yields obtained in HRS, Adilabad as potential yield were used in the calculation of Extension gap, Technology gap, Technology index and benefit-cost ratio as suggested by Samui *et al*. (2000) [2] by using the following formulae.

Extension gap = OFTs yield – Farmer practice yield

Technology gap = Potential yield – OFTs yield

Technology index (%) = [PY – OFTs / PY] x 100

Additional Cost (Rs ha^{-1}) = Demonstration Total Cost – Farmers' Practice Total Cost

Additional Return (Rs ha^{-1}) = Demonstration Return – Farmers' Practice Return

Net returns (Rs ha^{-1}) = Total (Gross) Returns – Total Cost of Production

Benefit Cost Ratio = Net returns (Rs ha^{-1}) ÷ Total cost of production (Rs ha^{-1}).

Where,

FPY = Farmers Practice Yield, PY= Potential Yield of variety obtained at HRS, Adilabad.

Results and Discussion

Agriculture is the mainstay of the economy of the Adilabad district, cotton, soybean, paddy, jowar, maize, and pulses are the main crops in the district. In the winter season, the majority of farmers raise chickpea, and safflower and few farmers sow seed spices such as ajwain and coriander. The reason for the lesser area under seed spices, farmers are relatively unaware of market trends and the associated benefit-cost ratio. Application of T. viride as seed treatment @10g kg^{-1} seed or soil application @ 2.5 kg ha^{-1} mixed with 50 kg of FYM at the time of sowing, Two sprays of Neem oil (2%) at 10 days intervals during flowering in evening hours to control aphid populations are the changes made in existing farmers practices.

Seed Yield

The yield gap analysis of seed spices varieties indicates that yield in OFTs was higher compared to farmers' practice in all villages (Table 2). The average yield of ajwain (649 kg ha^{-1}) and coriander (899 kg ha^{-1}) were much higher as compared to farmers practice. The average percentage increase in the yield over farmer's practices was 24.81 and 20.27 in ajwain and coriander respectively. Results of on-farm trials with improved variety (AA 93) and other recommended packages of practices had shown positive outcomes in terms of increased yield and other indicators studied in comparison to local check. The reasons for the low yields were partly due to the farmer's variety which has a long duration and has been in cultivation for the past 30 years. In seed spices, the seed replacement rate (SSR) is below 15% which can be overcome by the introduction of newly developed varieties (Gopal 2018) [6].

In the Jainad cluster, the overall yield obtained was higher than in the Bela cluster because of fertile lands, early adopters and a keen interest towards new technologies. The farmer practice yield in the Jainad cluster was more (792 kg ha^{-1}) compared to the Bela cluster (641 kg ha^{-1}). by using improved recommended production technologies the on-farm yield (949 kg ha^{-1}) in the Jainad cluster was more (850 kg ha^{-1}) than in the Bela cluster. However, the percentage yield increase when compared to that of farmers' practice has been increased in the Bela cluster (24.49%) than in the Jainad cluster (16.49%).

Technology gap, Extension gap and Technological Index analyses

The mean average technology gaps were 241 kg ha^{-1} for Ajwain, 300 kg ha-^{1} for Coriander (Table 3) and the higher technological gap in the Bela cluster than Jainad. The technology gap between clusters might be attributed to the variation in the soil fertility, irrigation water, microclimate, incidence of pests and diseases, level of crop management by farmers and other responsible factors in this gap. The higher seed yields in OFTs were due to the cultivation of high yielding short duration varieties AA 93 (Ajwain) and Suguna (Coriander) which were found better than the local varieties being grown by the farmers, seed treatment to protect pests and diseases before sowing. Scientific interventions with improved short-duration varieties and adoption of the recommended package of practices are the factors responsible for exploiting higher yields over farmer's practices. The data presented in Table 3 showed that the highest mean extension gap of 181 kg ha-1 was recorded in coriander followed by 160 kg ha-1 for ajwain. This large extension gap emphasized that there was a need to raise awareness about the use of high-yielding varieties in conjunction with a better package of techniques to reverse this trend of the wide extension gap. The mean technology index data for Ajwain was 27.0 per cent and for Coriander 25.0 per cent. Numerically similar values of the technology index showed that the intervened technology was widely accepted and viable by the farmers.

Economic analysis

The outcomes of the economic analysis (Table 4) of seed spices revealed that the cultivation of ajwain, and coriander under improved technologies gave higher gross (Rs. 1,29,822, and Rs. 1,43,984 ha-1) and additional returns (Rs. 32,055, Rs. 28976 ha-1) compared to farmers' practice. The inputs and outputs prices of commodities that prevailed during the study of demonstrations were taken for calculating the cost of cultivation, gross return, net return, additional income, and the benefit-cost ratio. The benefit-cost ratio of ajwain and coriander under improved technologies were 5.47 and 5.58 suggesting that the improved production technologies are technically feasible and economically viable. Similar results of increasing yields

in different seed spices crops were reported by Bhoraniya *et al.* (2017) [9], Dhaka *et al.* (2015) [1], Garwal and Arora (2013) [11], Lal *et al.* (2013) [13], Meena *et al.* (2016) [14] and Poonia *et al.* (2017) [15].

Table 2: Cluster-wise yield performances of ajwain and coriander varieties with improved production technologies under OFTs.

Cluster	No of Demonstrations	Area (ha)	Yield (kg ha^{-1})		Increase in Yield over Farmer Practice %
			Farmers Practice	OFT Yield	
Ajwain					
Jainad	8.0	3.2	557	656	15.17
Bela	8.0	3.2	420	641	34.44
Average	8.0	3.2	488	649	24.81
Coriander					
Jainad	8.0	3.2	796	949	16.06
Bela	10.0	4.0	641	850	24.49
Average	9.0	3.6	718	899	20.27

Table 3: Extension Gap, Technology Gap and Technology Index analyses of ajwain and coriander varieties with improved production technologies under OFTs.

Cluster	Potential Yield (kg ha^{-1})	Extension Gap (kg ha^{-1})	Technology Gap (kg ha^{-1})	Technology Index
Ajwain				
Jainad	890	100	233	26.20
Bela	890	221	249	27.93
Average	890	160	241	27.07
Coriander				
Jainad	1200	153	251	20.88
Bela	1200	209	350	29.13
Average	1200	181	300	25.00

Table 4: Economic analyses of ajwain and coriander varieties with improved production technologies under OFTs.

Cluster	On-farm returns (Rs ha^{-1})	Farmers practice returns (Rs ha^{-1})	Additional Cost (Rs ha^{-1})	Additional returns (Rs ha^{-1})	B: C ratio
Ajwain					
Jainad	1,31,355	1,11,444	2615	19,911	5.53:1
Bela	1,28,288	84,088	2615	44,200	5.40:1
Average	1,29,822	97,766	2615	32,055	5.47:1
Coriander					
Jainad	1,51,904	1,27,424	2,464	24,480	5.82:1
Bela	1,36,064	1,02,592	2,464	33,472	5.35:1
Average	1,43,984	1,15,008	2,464	28,976	5.58:1

Conclusions

Introduction and adoption of high-yielding Ajwain variety 'AA93' and coriander variety 'Suguna / LCC-236' with improved package of practices through on-farm testing achieved 20 to 24% higher seed yields over farmer practice with an additional expenditure of Rs. 2464 to 2615 per ha. These varieties may be popularized with a full package of practices to explore the potential under field conditions and mitigate the extension gap, simultaneously efforts are needed to reduce the large technology gap described in this paper. The additional input costs incurred are very meagre and may be borne by small and marginal farmers. Hence, it is clear from the study that cost is not the constraint here concerning the adoption of the technology but lack of knowledge is the basic reason identified as the extension gap. The average extension gap recorded in the investigation was 160 to 180 kg ha^{-1}. The high benefit-cost ratio in the present trials was enough to motivate the neighbor farmers for full technology adoption to achieve higher returns.

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