Tobacco Research 48(2): 74-80, 2022

STRATEGIES FOR OROBANCHE MANAGEMENT IN FCV TOBACCO

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(Recieved on 14th Nov., 2022 and daccepted on 26th Dec., 2022)

The present study is an attempt to analyze the strategies perceived by the tobacco farmers with respect to *orobanche* management in FCV (Flue Cured Virginia) tobacco. *Expost facto* research design is used, and random sampling technique is employed in selection of respondents. The study is based on field survey and interaction with FCV tobacco farmers in Andhra Pradesh and Karnataka. The primary data was collected during 2021-22 from 30 randomly selected FCV tobacco farmers in each of the two tobacco growing regions *viz.*, Southern Light Soils (SLS) & Southern Black Soils (SBS) in Prakasam and Nellore districts of Andhra Pradesh and Karnataka Light Soils (KLS) region in Mysuru district of Karnataka thus making total sample size of 60 respondents. In the present study, the strategies perceived by the farmers to effectively implement *Orobanche* management practices in FCV tobacco growing regions were identified for both the regions. Results showed that community approach and crop rotation practices at farmers' end; convergence operation and village adoption programmes at institutional level; experiments in farmers' fields and multi-location trials at research and development side; rapport and linkage with stakeholders and sound technical expertise at extension level; crop insurance, national level mass campaigns and strict quarantine measures at policy level are the most important strategies.

INTRODUCTION

Reduction in economic losses in agricultural production due to various abiotic and biotic factors is of utmost importance in modern day input-intensive agriculture. According to Das *et al.,* (2020), the total annual loss of agricultural produce in India by weeds, insects, diseases and other pests are estimated to be 37%, 29%, 22% and 12%, respectively. Among the major biotic constraints, weeds particularly parasites are considered as the most harmful to agricultural production. Weeds are, mainly, autotrophs, but few are heterotrophs/parasitic such as *Orobanche* species, which is the most threatening and widespread root parasite in many economically important crops *viz.*, tomato, tobacco, potato, brinjal, sunflower, mustard, melon, chickpea etc. Ahmad *et al.,* (2018) reported that worldwide annual crop losses as a result of broomrape infestation are estimated at about $1.3 to 2.6 billion. According to Dhanapal *et al.,* (1996) and Qasem (2021), the damage caused by *Orobanche* can range from zero to complete crop failure depending upon the extent of infestation, environmental conditions, soil fertility and crops' competitiveness. As the *Orobanche* entirely depends on host plants, at times it will be devastating where mono-cropping is practiced in succession. This parasite infestation is not an exception in commercial crops among which, particularly *Orobanche cernua* is severe problem in tobacco. During 2014-15 season, Punia (2014) estimated that in Andhra Pradesh, 50% area under tobacco (40,000 ha) was infested with broomrape and caused 50% crop loss.In Karnataka, 90% area under tobacco was infested with this parasite with 50-60% yield losses.

Among different crops grown, farmers reap riches in cultivation of FCV (Flue Cured Virginia) tobacco in specific regions of Andhra Pradesh and Karnataka as these are the major FCV tobacco growing regions of the country. During 2021-22, the area planted under FCV tobacco was 65,142 ha and 73,609 ha in Andhra Pradesh and Karnataka respectively (Tobacco Board, 2021).

Keywords: Farmers, FCV tobacco, Management, *Orobanche* and Strategies

Orobanche has become a menace to Indian FCV (Flue Cured Virginia) tobacco which is threatening the farming community to rethink for alternative options. Although management practices are available, its implementation at grass root level is often impeded due to multiple factors. To tackle these issues, suitable strategies must be devised keeping current technological scenario and stakeholders' perspective. Therefore, the present study has been carried out with an objective to analyze strategies with respect to *Orobanche* management in FCV tobacco.

METHODOLOGY

The study employed *Expost facto* research design and random sampling technique in selection of respondents. The present study is based on field survey and interaction with FCV tobacco farmers in Andhra Pradesh and Karnataka. These states were purposively selected as these are the key FCV tobacco growing regions of the country. Different parameters were identified to analyze the strategies perceived by the stakeholders. The primary data was collected from 30 randomly selected FCV tobacco farmers in each of the two tobacco growing regions *viz.*, Southern Light Soils (SLS) & Southern Black Soils (SBS) in Prakasam and Nellore districts of Andhra Pradesh and Karnataka Light Soils (KLS) region in Mysuru district of Karnataka thus making total sample size of 60 respondents. To analyze the strategies opined by the respondents in *orobanche* management, a suitable semi structured interview schedule was developed based on the discussion with experts, farmers and through data from relevant review of literature. The data collected were coded, tabulated and to devise strategies, Friedman's non-parametric test was employed for analysis.

RESULTS AND DISCUSSION

The strategies reflect the priorities perceived by the farmers to effectively implement *Orobanche* management practices in FCV tobaccogrowing regions. The strategies in the form of interventions are broadly categorized into farmer, institutional, research and development, extension and policy levels. The respondents were asked to rank the preferences starting from
1 = to a very low extent to 5 = to a very high extent on different interventions. The total score of each component was considered and further compared using Friedman's test.

Perusal of Table 1 showed that community approach and individual social responsibility are the important interventions perceived by SLS&SBS farmers. It was found in the study area that very few progressive farmers follow timely management practices in the highly affected areas of *Orobanche*. One of the main reasons could be that unlike other pests and insects, the losses caused by parasites are invisible, fast spreading and many a time these are ignored by the farmers in spite of the fact that they cause maximum losses. Therefore, community approach is the need of the hour in order to maintain parasite populations below the threshold levels of damage. This cooperative approach particularly among small and marginal farmers is essential if the efforts are initiated at the farmers' end. Similar findings were reported by Fernandez *et al.,* (2016) and Habimana *et al.,* (2014). Individual social responsibility deals with individuals becoming

Table 1: Farmer level interventions for *Orobanche* management

(N=60)

Interventions	Mean score	Rank	Mean score	Rank
	Andhra Pradesh (SLS&SBS)		Karnataka (KLS)	
Individual Social Responsibility	4.55	II	2.34	V
Farm journalism	2.34	V	4.75	III
Model farms	3.89	III	4.76	II
Community approach	4.65	I	3.34	IV
Crop rotation	3.46	IV	4.98	I

more responsible in their actions affecting communities, in their immediate circle of family and friends and also beyond. Generally, tenant farmers have the tendency to leave the pulled-out parasite shoots on field bunds. This type of attitude affects other farmers in the village. Hence, every farmer should have equal responsibility in farm management practices for the benefit of farming community.

KLS farmers opined that crop rotation is the most important strategy for parasite management. In the study conducted by Dongola (2006) stated that rotation of tomato with onion reduced *Orobanche ramosa* infestation by 90-95% and increased tomato yield by 60%. Punia (2014) mentioned that crop rotation with trap crops causing suicidalparasite germination*viz.,* sesame, brown Indian-hemp, common flax and black-eyed pea decreasedbroomrape biomass by 86, 85.3, 75.2, and 74.4 percent, respectively. Acharya *et al.,* (2002) observed 33.35 % reduction in seed bank of *Orobanche* by usingtoria as a catch crop. Establishment of model farms in the villages and farm journalism scored almost equal weightage by the farmers. As farmers believe what they see, model farms and wider publicity of successful case studies of farmers followed best *Orobanche* controlled measures certainly motivates fellow farmers to replicate similar management practices in their fields.

From the Table 2 it is clear that in case of FCV tobacco, SLS and SBS farmers expressed that convergence working mode of ICAR-CTRI, Tobacco Board and trade coordinate the activities and personnel and avoids duplication of effortsin devising management strategies. Presently, ICAR-CTRI is recommending incorporation of 100 kg of neem cake/acre in the last ploughing of FCV tobacco for SLS & SBS regions and dollop method of neem cake application @ 100 kg/acre on both sides of plants (30-35 days) for KLS region to control orobanche. The results reported by Das *et al.,* (2020) showed that application of 200 kg/ha neem cake and 2 kg/ha copper sulphate at sowing in mustard as separate treatments showed 34 per cent and 41 per cent reduction in *Orobanche* density in Rajasthan. However, the interaction with the informants revealed that although the benefits of neem cake application is widely known for plant protection but 70 per cent of farmers in the present study area are not aware of this recommendation particularly to *Orobanche*. Farmers felt that this type of inputs should be distributed freely on timely basis to all the tobacco farmers. As most of the farmers of the agroecosystem are nature lovers and they easily adopt neem cake application. Capacity building programmes to the farming community is the third most important strategy. This shows two aspects - one is cognitive *i.e.* knowledge building of farmers on physical, chemical and cultural methods of *Orobanche* control and second aspect is psychological that is building their confidence to break the myth among farmers that *Orobanche* is uncontrollable.

KLS farmers ranked village adoption programmes is the most important intervention required for their region. This type of adoption facilitates timely knowledge and inputs from the subject matter experts. In this context, the mandate of the government to adopt villages through "Mera Gaon Mera Gaurav (MGMG)" scheme in 2015 envisages scientists of every ICAR

Table 2: Institution level interventions for *Orobanche* management

(N=60)

Interventions	**Mean score**	**Rank**	**Mean score**	**Rank**
	Andhra Pradesh (SLS&SBS)		**Karnataka (KLS)**	
Convergence operation	4.69	I	4.11	III
Capacity building programmes	3.63	III	1.89	V
Free distribution of recommended inputs	4.66	II	2.47	IV
Maintenance of data base	2.99	V	4.25	II
Village adoption programmes	3.45	IV	4.31	I

institutes, SAUs, KVKs to adopt villages and provide information to the farmers on technical and other related aspects in a time frame. This ongoing scheme can also be utilized for *Orobanche* management as it facilitates direct interface of scientists with the farmers. Maintenance of data base on *Orobanche* occurrence and yield loss is the second most important strategy. Yield losses due to parasites are very important statistics for assessment of effectiveness of current plant protection measures. As far as yield loss by different *Orobanche* species is concerned, Das *et al.,* (2020) reported 12-40% in Faba bean, 20-55% in sunflower, 30-55% in tomato, 25-50% in tobacco, 80% in chilli, 20-40% mustard, 20-70% in musk melon and watermelon.

Analysis of research and development interventions from Table 3 showed that experiments in farmers fields ranked as topmost strategy by SLS & SBS farmers. Most of the studies conducted on economic loss due to parasites is based on the experimental data which may not be always representative for field situation. Although, estimation of yield losses from experimental conditions is subject to local effects and sometimes it is valid only for specific cropping situations and it is difficult to extrapolate the results for yield losses at farmers' level. Further, it is more realistic to establish results from field trials comparing the different treatments in the farmers' fields. Hence, to observe the magnitude and variability of yield losses due to parasites, experiments on farmers' fields are needed. For this, highly infected famers fields should be identified, and experiments should be conducted. These findings were supported by the study conducted by Gharde *et al.,* (2018) where data from farmers' fields on yield losses due to weeds is important in devising actual appropriate management strategies. Further, it was notable in the results that novel chemical/biological/ biotechnological methods is the need of the hour. In the study conducted by Sheoran *et al.*,(2014)stated that foliar application of glyphosate twice, 25 g/ha at 30 DAS (Days after sowing) followed by 50 g/ha at 55 DAS would be very helpful in minimizing *Orobanche* infestation by reducing the seed loadwithout any yield loss in mustard. Among the biological measures, systematic studies conducted by Klein *et al.*, (2002), Kroschel*et al.*, (2004) Abang *et al.*, (2007) highlighted that the broomrape fly (*Phytomyza orobanchia*) is a widely occurring insect-pest of *Orobanche* species in Near East and North Africa (NENA) countries and natural reduction of *Orobanche* seed production of 11-79% has been reported from several NENA countries. Crop breeding and biotechnological research for fostering *Orobanche* resistance in host crops should be more prioritized.

The results from KLS region conveyed that multi location trails with the existing All India Network/Coordinatedprojects can be further intensified to devise control measures for *Orobanche*. Das *et al.,* (2020) and Macias *et al.,* (2019) mentioned that numerous synthetic analogues of the natural stimulants, such as GR 7, GR 24 and GR 45 are available, which can stimulate *Orobanche* germination. They when used before crop sown induce *Orobanche* germination, but the seedlings wither away in the absence of a suitable host plant amounting to "suicidal germination" or "honeypot strategy". Conduct of

Table 3: Research and development interventions for *Orobanche* management

(N=60)

Interventions	Mean score	Rank	Mean score	Rank
	Andhra Pradesh (SLS&SBS)		Karnataka (KLS)	
Glass house/pot culture experiments	2.36	IV	4.58	III
Testing of artificial stimulants	1.45	V	4.66	II
Multilocation trials	3.93	III	4.67	I
Novel chemical/biological/ biotechnological methods	3.96	II	4.53	IV
Experiments in farmers' fields	4.51	I	3.25	V

glass house/pot culture experiments to get accurate results ranked as second most important strategy expressed by farmers. Qasem (1998) initiated studies in the similar lines on chemical control of branched broomrape (*Orobanche ramosa*) in the glasshouse grown tomato.

Findings from Table 4 showed that SLS & SBS farmers perceived rapport and linkage with stakeholders in the village is highly important as farmers acquire farm related information from different sources. Study conducted by Singh *et al.,* (2016) found that the potential sources of information for farmers were progressive farmers (28%), radio (14%), television (13%), newspaper (9%), extension worker (4.2%), credit agency (4%), input dealer (3.8%), village fair (2.9%), cooperative society (2.8%) and NGO (2.6%). In fact, adoption always happens over a period and association of the farmers with various information sources definitely creates motivation. Farmers also opined that performance linked incentives should be given to those farmers who practice recommended measures. Success stories of those farmers should be extensively covered in print media and electronic media to motivate fellow farmers.

In KLS region, it is evident in the results that the adoption of any recommended strategies by the farmers is driven by a variety of different reasons such as socio-economic, structural and institutional factors. To achieve this, knowledge is an important variable and every extension agent should be technically sound which ultimately results in successful adoption by the farming community. This is in line with the findings reported by Hema *et al.,* (2021) stated that contact with extension agents is crucial for technology transfer. Haleem (2018) similarly opined that extension agents who are responsible for latesttechnological outreach to the farming communities should possess sound knowledge on latest recommended practices.

A glance at Table 5 revealed that crop insurance is the topmost strategy expressed by the farmers in both the study areas. It is known fact that risks and uncertainties are common in agriculture, as there is a lag between decision-making and realizing returns. There are several factors that affect the returns from farming, many of which are beyond the control of farmers. Among them, *Orobanche* damage to the crop ranges from

Table 4: Extension interventions for *Orobanche* management

(N=60)

Interventions	Mean score	Rank	Mean score	Rank
	Andhra Pradesh (SLS&SBS)		Karnataka (KLS)	
Technical expertise on GAP	3.87	III	4.82	I
Literature in local language	3.25	IV	3.11	III
Performance linked incentives	4.11	II	4.78	II
Training to key informants	3.19	V	1.52	V
Rapport and linkage with stakeholders	4.95	I	3.05	IV

Table 5: Policy interventions for *Orobanche* management

(N=60)

Interventions	Mean score	Rank	Mean score	Rank
	Andhra Pradesh (SLS&SBS)		Karnataka (KLS)	
Crop insurance	5.00	I	5.00	I
National level programmes	4.99	II	3.89	IV
Infrastructure development	3.41	IV	2.55	V
Funding through schemes	4.62	III	4.48	III
Strict quarantine measures	3.28	V	4.51	II

minimal to complete crop loss if timely measures are not taken. Coming to crop insurance, Mahul *et al.,* (2012), opined that India has the largest number of uninsured farmers in the World.The factors like lack of awareness, lower social status, tenant farming and exposure to deficit-rainfall in the previous year are negatively associated with the decision to insure.Practically, government disaster payments are uncertain and subjected to many 'ifs and buts.'Therefore, farmers expressed that government should take serious steps in this direction to precisely estimate the loss and provide insurance to the farms. According to Aditya *et al.,* (2018) only 4.8 and 3.17%is the adoption of crop insurance in 2018 during *kharif* and *rabi* seasons, respectively. Even crop wise analysis reveals that the extent of insurance was less than 10% except for ground nut, soybean and cotton. In the two most important food crops in India, *viz.,* rice and wheat, the extent of insurance is less than 5 per cent.

ICAR organizes national level mass campaigns like parthenium awareness weeks mainly to appraise the farmers about harmful effects of weeds. Similar activities need to be initiated for *Orobanche* management by ICAR through agricultural institutes across India. It is also suggested to include this type of activities in Swachh Bharat programmes to be conducted in farmers' fields. KLS farmers also expressed that stringent quarantine measures need to be implemented at various levels *viz.,* regional, zonal, district, or community jurisdiction which helps in preventing the introduction of broomrape into parasite-free areas. Besides, funds from various sources both public and private should, therefore, be combined to support a single coordinated control effort in this direction. In the study conducted by Hema *et al.,* (2017) and Srinivas *et al.,* (2022) mentioned that agricultural research expenditure and capacity of research institutions should be utilized for scaling up the efforts.

CONCLUSION

The present paper discusses the future strategies for *Orobanche* management that require the attention of researchers, policy makers and other stakeholders. The findings of the study showed that the strategies perceived by the farmers on *Orobanche* management are greatly differed between FCV tobacco regions in Andhra Pradesh and Karnataka due to varied agro-ecological conditions, socio- economic status of the farmers, availability of resources and adoption behaviour of farmers. Among the different strategies, community approach, crop rotation, convergence operation, village adoption programmes, experiments in farmers' fields, multi-location trials, rapport and linkage with stakeholders, technical expertise, crop insurance, national level mass campaigns and strict quarantine measures are the most important strategies.

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