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RESEARCH ARTICLE

Efficiency and economics of broomrape (*Orobanche* spp.) control by different management practices in tobacco

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ABSTRACT

A field experiment was carried out at Research Farm of Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar during 2014-15 and 2015-16 to evaluate the effect of different weed management practices on yield and economics of tobacco. Five weed management treatments were tried out in a randomized block design with four replications. The results revealed that application of neem cake 200 kg/ha at sowing *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAP recorded the lowest broomrape population of 11.71 and 12.05/plant and maximum tobacco yield of 2.45 and 2.39 t/ha in both the years, respectively. Highest B : C (2.20) was obtained with neem cake 200 kg/ha at sowing followed by (*fb*) soil drenching of metalaxyl MZ 0.2% at 20 DAP followed by soil drenching of metalaxyl MZ 0.2% at 20 DAP. Hence, it was concluded that for better tobacco yield and broomrape (*Orobanche* spp.) control, neem cake 200 kg/ha at sowing *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAP was found to be the best practice.

Keywords: Broomrape, Economics, *Orobanche* spp., Metalaxyl MZ, Neem cake, Soil drenching, Tobacco

INTRODUCTION

The primary non-food crop grown in more than 100 countries is tobacco (*Nicotiana tabacum* L.) with a combined land area of 4.2 million hectares (Patel *et al*. 2018). Tobacco is a member of the solanaceae family and of the tubiflorae order, is thought to have been brought to India from its native Central America by the Portuguese in 1603 (Rani *et al*. 2023). China, the United States, India, Brazil, Turkey, Russia, Italy, and Zimbabwe are the top tobacco-producing nations in the world. About 36 million people in India are employed in the production, processing, marketing and export of tobacco, either directly or indirectly. As a result, a substantial portion of the population depends on this crop, especially rural women, tribal people, and other weaker groups in society (Krishnamurthy 2011, Punia 2014). Among different types of tobacco grown in the country, chewing tobacco plays a key role in the national economy in generating employment and income.

In Bihar, tobacco is an important crop but harvesting of it is significantly hampered by the growth of weeds. There is intense crop-weed competition for light, moisture, space, and nutrients as a result of the simultaneous emergence and rapid development of weeds. Broomrape (*Orobanche* spp.) is a total root parasitic annual herb that is propagated by seed. It ranks among the worst weeds in the tobacco crop. Seed germination in soil is induced by exudates from the host root. The host roots close by are then infected by the parasite seedlings, which develop haustoria on them. In just eight weeks, each plant can produce more than a million seeds and can cause yield reduction up to 60% (Patel *et al*. 2017 and Punia 2015). Currently, due to scarcity of human labour, manual weeding is becoming very difficult. Herbicides are one of the most important broomrape management tools in tobacco. Several studies have reported that low doses of total weed killer like glyphosate can stimulate plant growth due to hormesis effect (Ferrari *et al*. 2021). Moreover, glyphosate-based management system has many advantages, including low cost, excellent crop safety, broad spectrum of weed control, and application flexibility (Yadav *et al*. 2020). Presently, due to adverse soil and weather conditions, intercultural operations are not done on time and tobacco growers are dependent on the herbicide mixture for broad-spectrum weed flora; but it has limited choice of herbicides. Continuous use of the herbicides with same mode of action has already led to the problem of herbicide resistance in weeds of tobacco (Krishna *et al*. 2018). Hence, evaluation of integrated weed management approach based on different herbicides is very much required for effective control of weed flora especially broomrape in tobacco. Therefore, considering the importance of different management

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practices on tobacco, the present experiment was conducted to find out the effective management practices for broomrape control and increase yield under north Bihar conditions.

MATERIALS AND METHODS

A field study was conducted during two successive years (2014-15 and 2015-16) at Research Farm, Dr. RPCAU, Pusa. The experiment was laid out in a randomised block design with four replications. The experiment is comprised of five weed management treatments *i.e.*, neem cake 200 kg/ha at sowing followed by (*fb*) soil drenching of metalaxyl MZ 0.2% at 20 days after planting (DAP); imazethapyr 30 g/ha at 40 DAP; glyphosate 100 g/ha at 20 DAP; soil drenching of metalaxyl MZ 0.2% at 20 DAP; weedy check. The soil type was sandy loam having 0.47% organic carbon, alkaline in reaction (pH 8.54), 203.79 kg/ha available nitrogen, 25.09 kg/ha available phosphorus and 153.25 kg/ha available potassium. Tobacco variety *PT76* was transplanted in 90 × 90 cm spacing. Recommended dose of fertilizer 250 kg N, 70 kg P and 70 kg K/ha were applied. All the necessary cultural practices excluding weed management were carried out uniformly to bring the crop at maturity. Weeds were counted at 60, 90 DAP and at harvest using a quadrat of 0.25 square meter (0.5 x 0.5 m), and data obtained were expressed as number of *Orobanche*/plant. For economics analysis the prevalent market price of the chewing tobacco was considered to calculate gross and net returns and finally benefit–cost ratio was calculated. Statistical analysis was done by adopting appropriate method of Analysis of Variance (Gomez and Gomez 1984) and mean comparisons were performed based on the least significant difference (LSD) at 0.05 probability.

RESULTS AND DISCUSSION

Effect on weeds

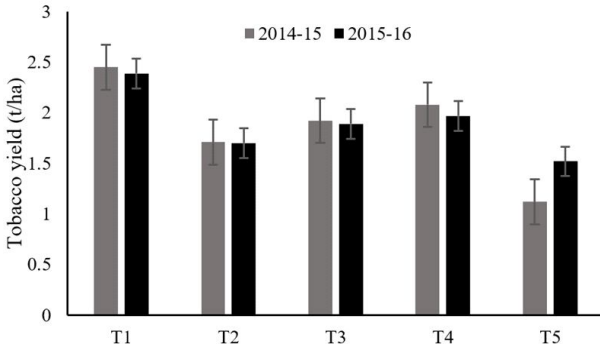
All the weed management treatments reduced the broomrape population as compared to unweeded weedy check in both the years (**Table 1**). Weedy check recorded significantly higher number of weeds than all the other treatments. At 60 DAP, neem cake 200 kg/ha at sowing *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAP recorded the lowest number of *Orobanche* (4.5 and 5.1/plant) in both the years, respectively respectively. The similar trend was followed at 90 DAP and at harvest. The number of *Orobanche*/plant was recorded 57.2% and 55.1% lower over both the years, respectively with treatment Neem cake 200 kg/ha at sowing followed by (*fb*) soil drenching of metalaxyl MZ 0.2% at 20 days after planting (DAP) than weedy check. This might be due to inhibitory effect of nitrogen to broomrape through application of neem cake at sowing, which effectively hindered the population of *Orobanche* spp. and soil drenching at 20 DAP controlled it later onwards.

Effect on yield

The tobacco yield was significantly influenced by different weed control treatments (**Figure 1**). Application of neem cake 200 kg/ha at sowing *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAP recorded significantly higher tobacco yield (2.45 and 2.39 t/ha, respectively) which was significantly superior over remaining other treatments during both the years. Moreover, application of neem cake 200 kg/ha at sowing *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAP improved the yield to the tune of 17.8% and 21.3% over the application of soil drenching of metalaxyl MZ 0.2% at 20 DAP in the both years respectively. In contrast, growth and yield of many solanaceae family crops were enhanced by low doses of glyphosate (Velini *et al*. 2008). Application of imazethapyr 30 g/ha at 40 DAP caused severe phytotoxicity on tobacco leaves. Thus, the growth of plant was severely stunted and size of leaves was decreased leading to loss in yield of the crop by 30.2% and 28.7% in both the years, respectively as compared. Whereas, Sousa *et al.* (2017) found that application metalaxyl altered carbon metabolism, which resulted in a reduction of growth and lower biomass accumulation due to impairment of carbohydrate production (total soluble sugar, starch, rubisco) and increased photorespiration in solanaceous plants. The minimum values of

Table 1. Broomrape population of tobacco as influenced by different levels of weed management practices

Treatment	Broomrape population (no. of *Orobanche*/plant)					
	60 DAP		90 DAP		At harvest	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
Neem cake 200 kg/ha at sowing *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAP	4.50	5.10	7.52	5.80	11.71	12.05
Imazethapyr 30 g/ha at 40 DAP	11.51	10.88	14.20	13.95	16.52	16.75
Glyphosate 100 g/ha at 20 DAP	9.92	9.10	12.81	11.93	15.20	15.18
Soil drenching of metalaxyl MZ 0.2% at 20 DAP	7.20	6.95	9.62	8.12	14.92	14.70
Weedy check	21.84	22.35	26.40	25.75	27.30	26.85
LSD (p=0.05)	0.75	0.65	1.85	1.83	2.19	2.12



T_1: Neem cake 200 kg/ha at sowing *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAP, T_2: Imazethapyr 30 g/ha at 40 DAP, T_3: Glyphosate 100 g/ha at 20 DAP, T_4: Soil drenching of metalaxyl MZ 0.2% at 20 DAP, T_5: Weedy check

Figure 1. Yield of tobacco as influenced by different levels of weed management practices

Table 2. Economics of tobacco as influenced by different levels of weed management practices (pooled data)

Treatment	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
Neem cake 200 kg/ha at sowing *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAP	478400	342600	2.20
Imazethapyr 30 g/ha at 40 DAP	341000	190200	1.26
Glyphosate 100 g/ha at 20 DAP	377400	227100	1.51
Soil drenching of metalaxyl MZ 0.2% at 20 DAP	395000	244200	1.62
Weedy check	305000	155000	1.03
LSD (p=0.05)	12365	12365	0.19

broomrape/plant throughout the crop growth period in neem cake 200 kg/ha at sowing followed by (*fb*) soil drenching of metalaxyl MZ 0.2% at 20 days after planting (DAP) could be the reason for higher yield of tobacco. Moreover, higher production of tobacco with neemcake application and soil drenching along with herbicidal treatments was due to low broomrape infestation as well as short broomrape competition period. These results are in agreement with the findings of Punia *et al*. (2021) and Singh *et al*. (2020).

Economics

Farmers' first consideration when deciding whether to adopt a new technology is the economics of produce. The results revealed that after two years of experimentation, maximum net returns of ₹ 342600/ ha along with B:C value of 2.20 was recorded under application of neem cake 200 kg/ha at sowing *fb* soil drenching of metalaxyl MZ 02% at 20 DAP which was significantly superior over rest of the treatments (**Table 2**). On the contrary, treatment imazethapyr 30 g/ha at 40 DAP; glyphosate 100 g/ha at 20 DAP excluding weedy check recorded minimum gross returns of ₹ 34100/ha, net returns of ₹ 190200/ha with B:C of 1.26. Higher profit was due to chemical control in tobacco have been supported by Mariam and Suwanketnikom (2004).

The present study has clearly demonstrated that tobacco responded well for integrated weed management practices. From the two years study, it was concluded that for effective control of broomrape and securing maximum yield of tobacco as well as profitablity, neem cake 200 kg/ha at sowing *fb* soil drenching of metalaxyl MZ 0.2% at 20 DAP should be applied in Bihar.

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