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# EFFECT OF TRAP CROP ROTATION CYCLES ON BROOMRAPE INFESTATION IN FCV TOBACCO

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**Tobacco is one of the common crops that are most seriously affected by broomrapes. Two species that commonly parasitize tobacco are *Orobanche cernua* and *Orobanche ramosa,* of which former is being most common in India. Trap crops like blackgram, greengram, sesamum, sunnhemp when grown in broomrape infested fields cause germination of the parasite but not allow the seedlings to establish and reduce the incidence of the parasite in succeeding tobacco. A field study was conducted in FCV tobacco with different trap crops and their rotation cycles at the Central Tobacco Research Institute Research Farm, Katheru, Andhra Pradesh with three trap crops and tobacco during *Rabi* season for four years. Lower infestation of 1.7 % at 75 days and 14.3% at 100 days was recorded in four year cycle of two year rotation of sorghum preceding two year tobacco. In four year cycle of three year rotation of sorghum preceding one year tobacco, 5.7 % and 14.0% infestation at 75 and 100 days after planting respectively was recorded. In two year rotation of sesamum preceding two year tobacco in four year cycle, 2.7 % and 28 % infestation at 75 and 100 days after planting respectively was recorded. In three year rotation of sesamum preceding one year tobacco in four year cycle, 6% and 19.3% infestation at 75 and 100 days after planting respectively was observed. Infestation and fresh weight of broomrape in tobacco crop was reduced and higher tobacco yields were recorded when tobacco was grown succeeding sorghum and sesamum in two and three year trap crop rotation cycles. Hand pulling for three years also reduced the infestation in monocropped tobacco. Hence, in highly infested fields of Orobanche in tobacco integration of trap crop of sorghum and sesamum rotation for two years with hand weeding for Orobanche management in Vertisols is recommended.**

## INTRODUCTION

Tobacco, is one of the important commercial crop grown in India with a cultivated area of 0.45 million ha, producing 760 million kg annually. Though tobacco considered to be a profitable crop for farmers, unlike other crops tobacco is also seriously affected by broomrape (*Orobanche* spp.). Two species of broomrape namely *Orobanche cermua* and *Orobanche ramosa* and are commonly parasitize tobacco of which former is being most common in India. The germination of broomrape seeds is triggered by the interplay of three factors viz. root exudates of host/ trap crop, low soil temperature and high soil moisture. A review of literature on control measures indicates that there is no single consistent, effective and economical method for complete eradication of broomrape infestation in tobacco. Trap crops like blackgram, greengram, sesamum, sunnhemp when grown in broomrape infested field cause germination of the parasite but not allow the seedlings to establish and reduce the incidence of the parasite in succeeding tobacco. In view of the beneficial effect of trap crop rotations in reducing the broomrape infestation in succeeding tobacco, a field study was conducted in FCV tobacco with different trap crops and their rotation cycles under Vertisols of Andhra Pradesh.

## MATERIALS AND METHODS

A field experiment was conducted during 2011-15 in the broomrape infested field at the Central Tobacco Research Institute Research Farm, Katheru, Andhra Pradesh with three trap crops and tobacco cv. VT 1158 during *Rabi* seasons for four years. The soils are silty clay slightly alkaline (pH 7.65), low electrical conductivity (0.30 dS/m), available N (212 kg/ha), organic C (0.42 %) and high in available P (31.0 kg/ha) and K (401 kg/ha). The experiment was conducted in RBD and replicated three times. The field experiment consisted of ten treatments

**Key Words:** Crop rotation cycles, Sorghum, Sesamum, Orobanche infestation, tobacco, yield

comprised of three crops viz. greengram, sesamum, sorghum cultivated for one, two and three years as trap crops preceding the tobacco and continuous monocropping of tobacco during *Rabi* season to see their rotation effect on *Orobanche* infestation in four years experimentation. The recommended package of practices were followed for cultivation of grain crops and tobacco during *Rabi* season with conserved soil moisture. The usual practice of hand removal of the broomrape was followed in all the treatments. Infestation (%) and fresh weight of broomrape at 75 and 100 days after planting (DAP) in tobacco and leaf yields of tobacco from 70 DAP onwards was recorded in the four years of the experiment. The data were statistically analysed and the results were presented.

**RESULTS AND DISCUSSIONS**

Orobanche infestation: In fourth year field crop observations on broom rape infestation (%) and fresh weight of broomrape (kg/ha) at 75 and 100 DAP taken in FCV tobacco in different treatments are presented in Table 1. Infestation (%) and fresh weight (kg/ha) of broomrape was higher where trap crops were grown for one year and tobacco grown for three years in four year cycle. Considerable reduction in infestation (%) and fresh weight was recorded where trap crops were grown for two years and three years and tobacco grown for two years and one year, respectively in four year cycles. Lower infestation of 1.7 % at 75 days and 14.3% at 100 days was recorded in four year cycle of two year rotation of sorghum preceding two year tobacco. In four year cycle of three year rotation of sorghum preceding one year tobacco, 5.7 % and 14.0% infestation at 75 and 100 days after planting respectively was recorded. Krishnamurthy *et al.*, (1977) also reported that the sorghum-tobacco rotation reduced infestation of *O.cernua* when compared to fallow-tobacco. In two year rotation of sesamum preceding two year tobacco in four year cycle, 2.7 % and 28 % infestation at 75 and 100 days after planting respectively was recorded. In three year rotation of sesamum preceding one year tobacco in four year cycle, 6% and 19.3% infestation at 75 and 100 days after planting respectively was observed. The use of trap crops offers the advantage of preferentially stimulating broomrape suicidal germination. Growing of trap crops such as jowar, gingelly, blackgram and greengram in *kharif* facilitates *Orobanche* germination but will not allow it to grow. The duration of rotation to obtain a satisfactory degree of broomrape control is not well known. It may be from 3- 4 years for *O.cernua* as shown in India (Krishnamurthy et al., 1977) to 4 years in Italy (Puzzilli, 1983), to 9-12 years (Zazzerini et al., 1981), up to 20 years for *O.*

**Table1: Tobacco plants infested and *Orobanche* fresh weight in tobacco in yearly crop rotations (4th year)**

| Crop rotation | % infestation | | No.of spikes | | Fresh wt kg/ha | | Total |
|---|---|---|---|---|---|---|---|
| | 75 DAP | 100 DAP | 75 DAP | 100 DAP | 75 DAP | 100 DAP | |
| G.gram –Tobacco-Tob-Tob. | 25.7 | 30.0 | 5.33 | 8.83 | 36.60 | 68.87 | 1055 |
| G.gram-G.gram-Tob-Tob | 16.3 | 22.0 | 4.67 | 8.67 | 27.57 | 54.74 | 822 |
| G.gram-G.gram-G.gram-Tob. | 9.7 | 13.3 | 5.50 | 8.50 | 10.75 | 36.59 | 473 |
| Sesamum- Tob-Tob-Tob | 6.3 | 28.7 | 3.50 | 12.50 | 19.77 | 56.27 | 756 |
| Sesame-Sesame-Tob-Tob | 2.7 | 28.0 | 5.33 | 12.17 | 19.11 | 54.77 | 738 |
| Sesame-Sesame-Sesame- Tob | 6.0 | 19.3 | 3.00 | 9.67 | 15.58 | 39.54 | 552 |
| Sorghum – Tob-Tob-Tob | 4.0 | 21.3 | 6.50 | 10.83 | 23.87 | 50.89 | 746 |
| Sorghum- Sorghum- Tob-Tob | 1.7 | 14.3 | 4.67 | 11.00 | 11.11 | 41.56 | 527 |
| Sorghum -Sorghum- Sorghum -Tob | 5.7 | 14.0 | 4.33 | 9.33 | 8.91 | 40.18 | 491 |
| Tob- Tob- Tob- Tob | 6.3 | 23.7 | 5.50 | 10.00 | 22.43 | 55.79 | 782 |
| S. Em± | 1.76 | 0.92 | 0.68 | 1.38 | 0.84 | 2.26 | |
| CD(P=0.05) | 5.24 | 2.72 | NS | NS | 2.49 | 6.71 | |
| Monocrop Tobacco Initial season | 73.3 | 93.8 | 7.23 | 11.83 | 2071 | 2557 | 4628 |

*ramose* (Lolas, 1984). Sesamum has been proved as a potential trap crop for control of broomrape in vegetables (Abebe *et al.,* 2005). Broomrape infestation in tobacco was significantly lower (1.75%) succeeding maize but higher in sole tobacco (21.54%) (Kasturi Krishna *et al* 2007). In fields infested with *O. crenata,* crops such as bean, flax, alfalfa, wheat and oat used in the crop rotation may reduce the soil seed bank of this broomrape (Abbes, 2008).

Continuous hand pulling for three years reduced the fresh weight from 4628 to 782 kg/ha in mono culture tobacco. In Greece, Oriental tobacco farmers hand-pull broomrape plants every week when tobacco is hand harvested (Lolas,1998). Though trap crop rotation was followed in *Orobanche* control, hand weeding was done to remove the spikes. Not only at 75 days it is essential to go for hand weeding even at 100 days also when weed infestation is noticed in the fields. Therefore it is essential for integration of trap crop rotation with hand weeding for Orobanche management in Vertisols. Weeding is laborious and time-consuming, and not very promising in highly infested areas. However, in combination with other methods, it can reduce the seed bank very efficiently (FAO, 2008). Combination of different methods of control into an integrated system is the best approach for effectively controlling broomrape thereby preventing damage and yield loss in field crops.

**Yield:** Though significant differences were not found in the green leaf yields, lower yields were recorded(Table 2) where trap crops were rotated for one year and also in sole tobacco treatment. Cured leaf production was significantly higher where tobacco was grown after grain crops rotated for three years when compared to one and two year rotation. Sorghum-Sorghum-Sorghum–Tobacco treatment, being on a par with sesamum trap crop for two years and three year cycles recorded significantly higher cured leaf yield as compared to four years monocultured FCV tobacco. Monocrop tobacco always recorded lower cured leaf and bright leaf yield due to *Orobanche* infestation. The diversions of water, minerals and assimilates to the parasitic weed causes moisture and assimilate starvation, host plant stress and growth inhibition which leads to extensive reduction in crop yield and quality in the Orobanche infested fields (Punia, 2014). Sorghum -Sorghum- Sorghum –Tobacco recorded significantly higher bright leaf yield followed by Sesame-Sesame-Sesame-Tobacco which was on par with bright yields of tobacco grown after one and two year rotation of sorghum and sesamum. Tobacco grown preceding greengram recorded lower bright leaf yields than sesamum and sorghum. Sole tobacco recorded lower cured leaf

**Table 2: Yield and quality of FCV tobacco in 4$^{th}$ year in four year rotation**

| Crop | Green leaf | Cured leaf | Bright leaf | GI | Nicotine % | Reducing Sugars % |
|---|---|---|---|---|---|---|
| G.gram –Tobacco-Tob-Tob | 12147 | 2001 | 440 | 1134 | 2.97 | 12.37 |
| G.gram-G.gram-Tob-Tob | 12602 | 2099 | 462 | 1200 | 2.99 | 12.00 |
| G.gram-G.gram-G.gram-Tob. | 13315 | 2147 | 472 | 1328 | 3.06 | 9.66 |
| Sesamum- Tob-Tob-Tob | 12931 | 2096 | 545 | 1182 | 3.03 | 13.34 |
| Sesame-Sesame-Tob-Tob | 13383 | 2209 | 574 | 1238 | 3.13 | 11.55 |
| Sesame-Sesame-Sesame- Tob | 13894 | 2238 | 582 | 1272 | 3.08 | 10.45 |
| Sorghum – Tob-Tob-Tob | 13052 | 2139 | 577 | 1217 | 3.42 | 8.67 |
| Sorghum- Sorghum- Tob-Tob | 12565 | 2101 | 567 | 1166 | 3.28 | 9.50 |
| Sorghum -Sorghum- Sorghum -Tob | 14110 | 2330 | 629 | 1333 | 3.02 | 12.52 |
| Tob- Tob- Tob- Tob | 11340 | 1988 | 398 | 1144 | 3.43 | 8.04 |
| S. Em± | 614 | 62 | 15.6 | 55.6 | 0.12 | 0.53 |
| CD(P=0.05) | NS | 184 | 46.4 | NS | NS | 1.59 |

and bright leaf yield. Significant differences were not found in the grade index values. However, higher values were observed in the tobacco grown after trap crops rotated for three years when compared to one and two year rotation.

It is concluded that infestation (%) and fresh weight (kg/ha) of broomrape in tobacco crop was reduced and higher tobacco yields were recorded when tobacco was grown succeeding sorghum and sesamum in two and three year trap crop rotation cycles along with hand weeding. Hand pulling for three years also reduced the infestation in monocropped tobacco. Hence, in highly infested fields of Orobanche in tobacco integration of trap crops of sorghum and sesamum rotation for two years with hand weeding for Orobanche management in Vertisols is recommended.

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