

**SURVEY OF PARASITIC WEEDS (*OROBANCHE* SPP.) ASSOCIATED WITH BRINJAL (*Solanum melongena*) IN BANDA DISTRICT OF UTTAR PRADESH INDIA**

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**ABSTRACT**

Three *Orobancha* spp. viz., *O. aegyptiaca*, *O. cernua* and *O. ramosa* were found to be associated with brinjal (*Solanum melongena*) in Banda district, India. However, the concomitant infestation of *O. aegyptiaca* with *O. cernua* and/ or *O. ramosa* in brinjal crop was not noticed. Moreover, some of brinjal fields showed the infestation of *O. aegyptiaca* with either *O. cernua* or *O. ramosa*. The infestation of *O. aegyptiaca* in brinjal planting was recorded in all the 20 examined localities. The highest (59.28%) and lowest (14.44%) weed incidence in brinjal fields was found in Chilla and Gazipur, respectively. The maximum (78.57 %) and minimum (28.33%) frequency of occurrence of *O. aegyptiaca* was found in Kurrahi and Palhari. The infestation of *O. cernua* in brinjal crop was observed in 14 localities, where the greatest disease incidence and frequency of occurrence of *O. cernua* were recorded Jakhni (29.29%) and Gazipur (38.89%). Whereas, the lowest disease incidence and frequency of occurrence of *O. cernua* was noticed in Hardauli (7.05 %) and Jamwara (16.67%), respectively. Moreover, the infestation of *O. ramosa* in brinjal crop was found in only nine localities of Banda district. The highest and lowest disease incidence due to *O. ramosa* in brinjal was recorded in Gazipur (28.33%) and Lakhanpur (5.29%), respectively. However, the maximum frequency of occurrence of *O. ramosa* was found in Jaspura (35.19%) and the minimum in Mahua (14.81%). In entire Banda district, 68.10% of the surveyed fields were infested with broomrapes. The highest disease incidence and frequency of occurrence of *O. aegyptiaca* were recorded in brinjal followed by *O. cernua* and *O. ramosa*. Thus, it is concluded that the brinjal crop cultivated in Banda district is under threat to varying degrees by *Orobancha* spp. infestation and there is great potential for the parasites to disseminate and infest new cultivated fields in absence of farmers' knowledge of problem and lack of effective management programmes.

**Keyword:** Broomrape, brinjal, disease incidence, disease frequency, parasitic weed

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## INTRODUCTION

More than 4,500 flowering plant species belonging to 20 families have been adapted to parasitize other plants. The parasitic plants can be classified as hemi parasites, which are photosynthetic and holo-parasites are absolutely devoid of chlorophyll and thus depend on their host plants for their nutrition (Rubails, 2018). The genus *Orobanche* includes more than 150 described species and most of them cause damage to a range of hosts from taxonomically distinct families such as Apiaceae, Amaryllidaceae, Asteraceae, Brassicaceae and Solanaceae (Parker and Riches, 1993; Akhter *et al.*, 2018; Akhter and Khan 2018a; Akhter and Khan 2018b; Akhter and Khan 2018c). These parasitic plants attach themselves to the crop roots and divert nutrient and bio-molecules, such as carbohydrates and amino acids required for normal physiological functions along with water and minerals, away from the host plants (Foy *et al.*, 1989).

The most destructive species of broomrapes are *O. aegyptiaca* (*Phelipanche aegyptiaca*), *O. cernua*, *O. cumana*, *O. crenata* and *O. minor*. The species of *Orobanche* are distributed across southern Europe, Northern Africa, the Middle East, South Asia and some parts of Africa (Parker, 2012). In India, three species of *Orobanche* viz., *O. aegyptiaca*, *O. crenata* and *O. ramosa* have been reported from brinjal, *Solanum melongena* L. (Akhter and Khan, 2018a; Kanwar, 2017; Kannan *et al.*, 2014). In India, the infestation of *Orobanche* spp. is largely found in Andhra Pradesh, Haryana, Punjab, Karnataka, Madhya Pradesh, Rajasthan, Uttar Pradesh and Tamil Nadu. (Akhter *et al.*, 2018; Akhter and Khan 2018a; Amit and Singh, 2005; Dhanpal *et al.*, 1998; Kannan *et al.*, 2014; Maharshi, 2001; Punia *et al.*, 2016; Rao and Chauhan 2015; Rao *et al.*, 2018; Shekhawat *et al.*, 2017; Sheoran *et al.*, 2015; Upadhyay, 2004).

Brinjal or eggplant (*S. melongena* L.) is an important solanaceous vegetable of sub-tropics and tropics. In India, brinjal is one of the most common, popular and

principal vegetable crops grown throughout the country except at higher altitudes. It has nutritive and medicinal value. During the year 2016, India produced 12.55 million metric tons of eggplant grown over the area of 664,000 ha (FAOSTAT, 2016). The broomrape may reduce yield of crops by 50% or more, especially where soil moisture is lacking. In India, the yield losses up to 30-35 % in brinjal have been reported due to *O. aegyptiaca* (Prasad *et al.*, 2009; Singh *et al.*, 2017).

In Banda district of Uttar Pradesh, several brinjal fields were found to be severely infested with broomrape. However, no comprehensive information so far is available on distribution of *Orobanche* spp. in brinjal fields of Banda district. On complaints by local farmers of the village-Kalinjar on prevalence of broomrape disease of brinjal, a systematic and extensive survey of brinjal fields at village level in all tehsils of the Banda districts were conducted. The aim of this study was to assess the disease incidence and frequency of occurrence of different broomrapes species infecting brinjal crop in Banda district of Uttar Pradesh, India.

## MATERIALS AND METHODS

A total of 240 brinjal fields were surveyed in 20 localities viz., Atarra, Barokhar, Bisanda, Chilla, Gazipur, Hardauli, Jakhni, Jalalpur, Jamwara, Jaspura, Kalinjar, Kurrahi, Lakhanpur, Mahua, Naraini, Oran, Palhari, Pangara, Reona and Tarkhari of Banda district of Uttar Pradesh, India. The surveys were carried out from January to March, 2015 to observe the infestation of *Orobanche* species in brinjal crop. During the survey period, the plants were in flowering and fruiting stages. In the survey no herbicide was applied, throughout the brinjal growing season against the pest. In each locality, 8-15 brinjal fields were randomly selected to observe the parasitism of broomrape. The brinjal plants infested with broomrapes were initially recorded on the basis of visual observation of the broomrape's shoots growing close to the stem of the plants. Infested plants along

with the broomrape shoots, were carefully uprooted without root damage to confirm the haustorial connection of parasite in the roots of brinjal. The samples of broomrape plants were collected and brought to the laboratory. The identification of *Orobanch*e species was done by using taxonomic key given by Parker and Riches (1993) and Joel and Eisenberg (2002). The *Orobanch*e spp. infesting brinjal plants were identified as *O. aegyptiaca*, *O. cernua* and *O. ramosa*.

In each field, positive for *Orobanch*e species, six quadrates of 2 m x 2 m size were randomly laid down to determine the number of brinjal plants infested with the broomrape and uninfested ones. The distance between quadrateto quadrate depended upon the size of the surveyed fields. The Important quantitative analysis such as disease incidence and frequency of broomrapes were calculated using the following formulae as suggested by Misra (1968):

$$\text{Disease incidence (\%)} = \frac{\text{Number of brinjal plants infested with } Orobanch\text{e spp.}}{\text{Total number of brinjal plants examined}} \times 100$$

$$\text{Frequency (\%)} = \frac{\text{Number of quadrates where the } Orobanch\text{e spp. occurred}}{\text{Total number of quadrates plotted}} \times 100$$

## RESULTS AND DISCUSSION

During the survey in Banda district, the concomitant infestation of *O. aegyptiaca* with *O. cernua* and/ or *O. ramosa* in brinjal plants was not noticed. Moreover, some of brinjal fields showed the infestation of *O. aegyptiaca* with either *O. cernua* or *O. ramosa* (Figure 1, 2 & 3, respectively). The infestation of all the three *Orobanch*e species in the same field was not recorded in none of the examined localities. The infestation of *O. aegyptiaca* in brinjal plant was recorded in all the 20 examined localities. The highest disease incidence was found in Tarkhari locality followed Palhari, Mahua, Kalinjar, Jakhni, Jaspura, Bisanda, Lakhanpur, Reona, Oran, Chilla, Jalalpur, Jamwara, Gazipur, Naraini, Barokhar, Hardauli and Atarra. In these respective localities the disease incidence of broomrapes was recorded as

100.00, 90.91, 90.00, 83.33, 75.00, 75.00, 73.33, 72.73, 72.73, 70.00, 66.67, 66.67, 64.29, 60.00, 57.14, 53.33, 53.33 and 50.00 %, respectively (Table-1).

The highest (59.28%) and lowest (14.44%) weed incidence in brinjal fields was found in Chilla and Gazipur, respectively. The maximum (78.57 %) and minimum (28.33%) frequency of occurrence of *O. aegyptiaca* was found in Kurrahi and Palhari. The infestation of *O. cernua* in brinjal crop was observed in 14 localities, where the greatest disease incidence and frequency of occurrence of *O. cernua* were recorded Jakhni (29.29%) and Gazipur (38.89%). Whereas, the lowest disease incidence and frequency of occurrence of *O. cernua* were noticed in Hardauli (7.05 %) and Jamwara (16.67%), respectively. Moreover, the infestation of *O. ramosa* in brinjal plants was found in only nine localities of Banda district. The highest and lowest disease incidence due to *O. ramosa* in brinjal was recorded in Gazipur (28.33%) and Lakhanpur (5.29%), respectively. However, maximum frequency of occurrence of *O. ramosa* was found in Jaspura (35.19%) and the minimum in Mahua (14.81%) (Table-2). The results revealed that in Banda district 68.10% of the surveyed fields were infested with broomrapes. In India the *Orobanch*e spp. distribution is wide, and continuously expanding (Akhter and Khan, 2018c).

In spite of the wide range of infested crops to the best of our knowledge, no comprehensive survey of different species of *Orobanch*e infesting of brinjal or other agricultural crops has been undertaken upto now. Although, in Jordan, Qasem (2009) surveyed the intensity of the infestation of broomrapes on different crops and found that three *Orobanch*e species viz., *O. aegyptiaca*, *O. cernua* and *O. ramosa* showed a high intensity of infection in brinjal plants, which is not accorded with our results. However, he further reported that the prevalence of *O. aegyptiaca* and *O. ramosa* in brinjal fields was high, whereas, *O. cernua* showed the limited prevalence. The *O. ramosa* showed highest infestation on several solanaceous

crops including brinjal in Khartoum and Gezira states of Sudan, where 57-100% of surveyed fields were infested and losses in yield range between 40-80 percent (Babikar and North, 2007; Donogla *et al.*, 2013). In conclusion, the brinjal crop grown in the district of Banda is threatened by *Orobanche* spp. infestation to varying degrees and there is great potential for parasites to spread and infest new cultivated fields in the absence of farmers' knowledge of the problem and lack of effective management program. Hence, research studies on control measures should be undertaken for the management of *Orobanche* spp. in brinjal fields.

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**Table-1. Occurrence of different *Orobanch* species parasitizing brinjal crop in district Banda, Uttar Pradesh, India.**

Localities	Number of fields surveyed	Number of fields positive for <i>Orobanch</i> spp.	Percentage of infested fields	Number of brinjal plant examined	Number of plants infested with <i>Orobanch</i> spp.		
					<i>O. aegyptiaca</i>	<i>O. cernua</i>	<i>O. ramosa</i>
Atarra	12	6	50.00	468	213	0	0
Barokhar	15	8	53.33	672	313	119	73
Bisanda	15	11	73.33	792	288	147	0
Chilla	12	8	66.67	528	313	117	0
Gazipur	10	6	60.00	540	78	113	153
Hardauli	15	8	53.33	624	313	44	0
Jalalpur	12	8	66.67	576	130	87	110
Jakhni	8	6	75.00	396	103	116	86
Jamwara	14	9	64.29	648	217	127	0
Jaspura	12	9	75.00	756	287	0	64
Kalinjar	12	10	83.33	840	367	102	0
Kurrahi	14	7	50.00	462	225	0	0
Lakhanpur	11	8	72.73	624	96	96	33
Mahua	10	9	90.00	594	130	45	69
Naraini	14	8	57.14	720	319	110	0
Oran	10	7	70.00	504	280	0	63
Palhari	11	10	90.91	780	448	0	0
Pangara	12	6	50.00	576	256	113	0
Reona	11	8	72.73	672	289	67	0
Tarkhari	10	10	100.00	780	287	0	145
<b>Mean</b>	-	-	68.10	-	-	-	-

**Table-2. Disease incidence and frequency of occurrence of *Orobanche* species infecting brinjal crop in Banda district Uttar Pradesh, India.**

Localities	Disease Incidence (%)			Frequency (%)		
	<i>O. aegyptiaca</i>	<i>O. cernua</i>	<i>O. ramosa</i>	<i>O. aegyptiaca</i>	<i>O. cernua</i>	<i>O. ramosa</i>
Atarra	45.51	0.00	0.00	72.22	0.00	0.00
Barokhar	46.58	17.77	10.86	52.08	25.00	16.67
Bisanda	36.36	18.56	0.00	40.91	25.76	0.00
Chilla	59.28	22.16	0.00	35.42	18.75	0.00
Gazipur	14.44	20.93	28.33	63.89	38.89	27.78
Hardauli	50.16	7.05	0.00	56.25	22.92	0.00
Jalalpur	22.57	15.10	19.10	37.50	35.42	22.92
Jakhni	26.01	29.29	21.72	58.33	30.56	19.44
Jamwara	33.49	19.60	0.00	53.70	16.67	0.00
Jaspura	37.96	0.00	8.47	38.89	0.00	35.19
Kalinjar	43.69	12.14	0.00	38.33	28.33	0.00
Kurrahi	48.70	0.00	0.00	78.57	0.00	0.00
Lakhanpur	15.38	15.38	5.29	60.42	20.83	18.75
Mahua	21.89	7.58	11.62	57.41	35.19	14.81
Naraini	44.31	15.28	0.00	39.58	27.08	0.00
Oran	55.56	0.00	12.50	54.76	0.00	26.19
Palhari	57.49	0.00	0.00	28.33	0.00	0.00
Pangara	44.44	19.62	0.00	75.00	36.11	0.00
Reona	43.01	9.92	0.00	47.92	29.17	0.00
Tarkhari	36.79	0.00	18.59	33	0.00	25
<b>Mean</b>	40.45	11.10	6.70	51.10	19.50	10.30

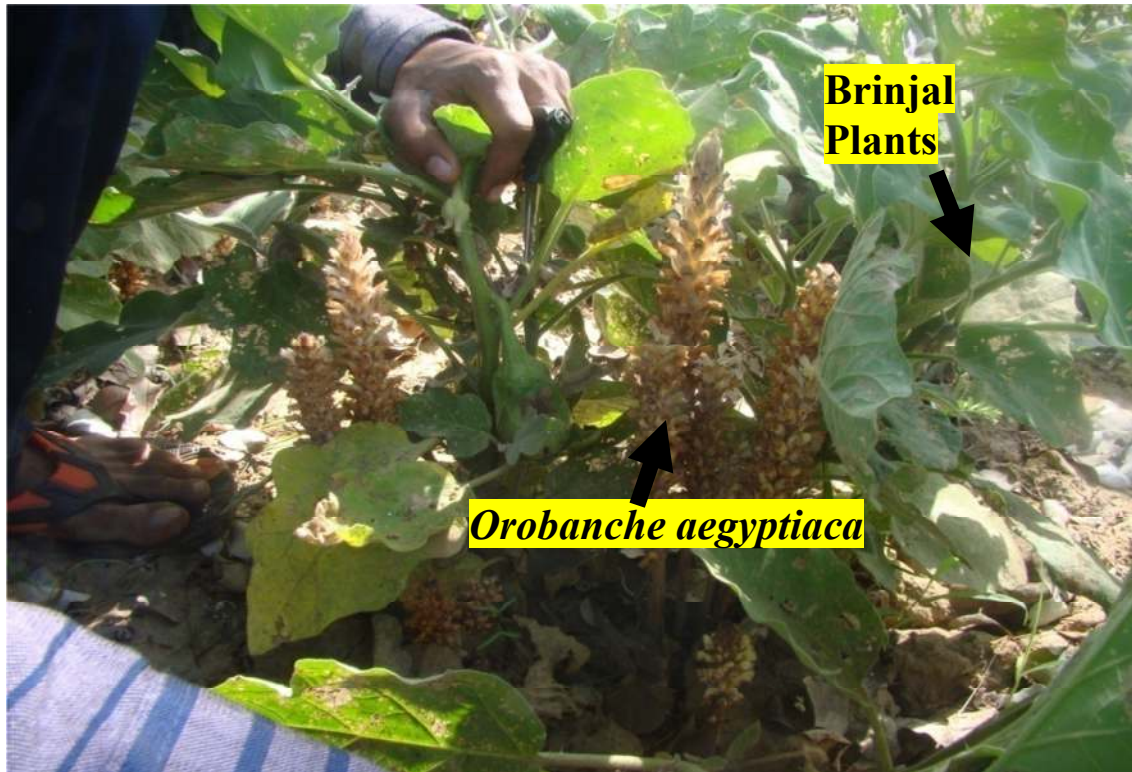


Figure 1. Brinjal field infested with *Orobanche aegyptiaca*.



Figure 2. Brinjal field infested with *Orobanche cernua*.



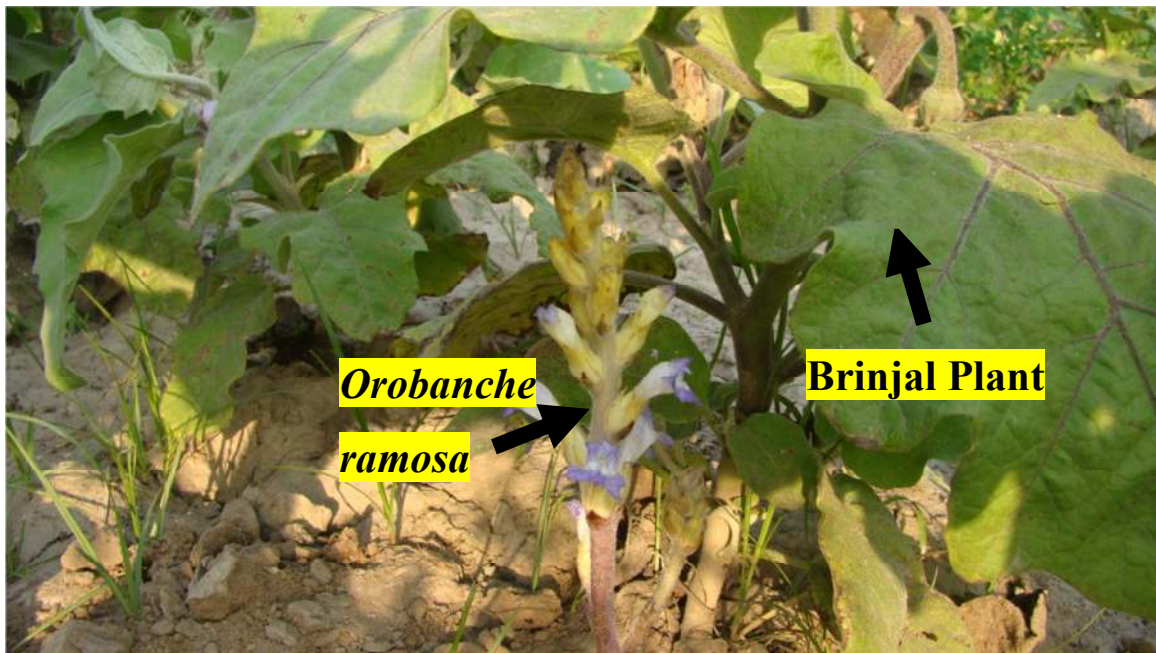


Figure 3. Brinjal field infested with *Orobanche ramosa*.