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Comparative performance of plant extracts, biocontrol agents and fungicides on the diseases of sunflower

R. Poorniammal and C. Sarathambal

Department of Agricultural Microbiology, TNAU, Coimbatore (Tamil Nadu)

¹Directorate of Weed Science Research, Jabalpur (Madhya Pradesh)

E-mail : poornimicrobiology@yahoo.co.in

ABSTRACT

A field study was conducted to find out comparative efficacy of plant extracts, biocontrol agents and chemical fungicides on leaf spot and rust. It was found that fungicide propiconazole 0.1% spray recorded the highest reduction in disease incidence of leaf spot (83.3%) and rust (79.5%) which was followed by neem oil spray 1% (62.8% and 64.2%). However, the biocontrol agents *Pseudomonas fluorescens* (42.31% and 44.43%) and pink pigmented facultative methylotroph (PPFM) (39.95 and 43.38%) performed slightly inferior when compared with neem oil and garlic extract. Lowest reduction in the disease incidence of leaf spot (18.2%) and rust (16.23%) were observed in *Prosopis juliflora* 10% extract. Similarly, when yield was estimated, highest yield was recorded in propiconazole 0.1% spray (1727 kg/ha) followed by neem oil spray 1% (1647kg/ha).

Key words : Weed extracts, *Calotropis gigantea*, *Prosopis juliflora*, Rust, Leaf spot

Plant diseases caused by various pathogens pose a serious threat in achieving sustainable yield and better quality production. Further, the indiscriminate use of chemical pesticides add to the problems of environmental pollution and human health hazards. Under these circumstances, the use of plant extracts of certain weeds in the management of disease would be a suitable alternative strategy. Many plants produce antimicrobial compounds as defense strategy against pathogens. In fact, several reports have been published on the antifungal activities of medicinal plants, herbs and cultivated plants (Miyakado 1986). Sufficient attention was not given to common weed species, despite the efficient allelopathic activities demonstrated by such weeds. Therefore, weeds may be the potential targets for seeking unknown and useful natural products that could lead for the development new biopesticides.

Calotropis gigantea commonly known as milkweed or swallow-wort, is a common wasteland weed. Allelopathic effects of *Calotropis* on different agricultural crops have not been well studied. *Prosopis juliflora* found on roadsides, watercourses, river flats and coastal dunes, thrives on poor soils particularly where overgrazing has removed competition from native grasses. Eradication of *P. juliflora* has proven to be extremely difficult or impossible, and hence there is a need to consider control through its exploitation as a resource. During the past few years, there is a growing trend all over the globe to shift from synthetic to natural products, including in the case of treatment of human diseases with the use of natural products from medicinal plants. Now it is high time, to

consider neglected and little known botanicals that too from weeds to cure the plant diseases.

Sunflower is cultivated in India over an area of 21.62 lakh ha with a production of 12.24 lakh tonnes. Among various diseases infecting sunflower, *Alternaria* blight caused by *Alternaria helianthi* (Hansf.) has been considered as a potentially destructive disease in India. The disease is known to cause more than 80% of yield loss under severe epiphytotic conditions (Shankergoud *et al.* 2006). There is no resistant variety available against this disease. The increased reflection on environmental concern over pesticide use has further encouraged for the exploitation of potential antagonistic micro flora in disease management. Plant extracts have played significant role in the inhibition of seed-borne pathogens and in the improvement of seed quality and field emergence of plant seeds (Nwachukwe 2001). If this antimicrobial property is present in a weed that will be an added advantage. Fungicidal properties of crude extracts of neem and garlic have been established earlier by several workers. In this context, the leaf extract of two prominent weeds *Calotropis gigantea* and *Prosopis juliflora* were evaluated for the management of important diseases of sunflower.

The experiment was conducted from October 2005 to February 2006 in Tamil Nadu Agricultural University, Coimbatore. Sunflower variety *KBSH-1* was used in the experiment. The experiment was laid out in a randomized block design with three replications. All the cultural operations were done as per recommended package of practices. The treatments were adopted at 30, 45 and 60

days after sowing. Eight treatments were as follows: T₁- Garlic extracts 1% spray, T₂ -Neem oil 1% spray, T₃ - *Calotropis gigantea* leaf extract 10% spray, T₄ - *Prosopis juliflora* leaf extract 10% spray, T₅ -Propiconazole 0.1% spray, T₆ - *Pseudomonas fluorescens* 1% (phyllosphere spray), T₇ - PPFM 1% (pink pigmented facultative methylotroph), T₈- Control

For the preparation of extract in cold water, fresh leaf samples were collected and washed in tap water. It was then processed with sterile water at 1 ml per gram of tissue (1:1w/v) in a waring blender and filtered through a double layered cheese cloth. This formed standard solution (100 per cent). The extracts were further diluted for required concentration.

Observations on per cent disease incidence, severity/intensity were recorded after each spray. Five plants from one replicate were selected for scoring the disease. The per cent disease index (PDI) was calculated using the formula:

$$\text{PDI} = \frac{\text{Sum of numerical rating}}{(\text{Total number of leaves infected} \times \text{Maximum category value})} \times 100$$

The disease intensity was calculated based on the infection index given by Mc Kinney (1923). Based on percentage disease severity, the accession were grouped in to six categories namely, healthy for '0' category value (CV), <1 for 1CV, 1-5 for 3CV, 6-25 for 5CV, 26-50 for 7CV and 51 and above for 9 CV.

The maximum reduction in the leaf spot disease caused by *Alternaria helianthi* was observed in plants sprayed with propiconazole (83.38%) followed by neem oil (62.88 %) when compared with the control. *Pseudomonas fluorescens* 1% spray recorded a reduction of 42.31% followed by PPFM (pink pigmented facultative methylotroph) (39.95%) and the least reduction was observed in the plants sprayed with 10% *Prosopis juliflora* extract (18.2%) (Table 1). Similar results on the use of extracts of *Calotropis gigantea* and *Prosopis juliflora* against *Alternaria helianthi*, the causal agent of alternaria blight of sunflower, was reported by Mesta *et al.* (2009).

Table 1. Effect of weed and plant extracts on the incidence of leaf spot and rust in sunflower

Treatments	Leaf spot (<i>Alternaria helianthi</i>)		Rust (<i>Puccinia helianthi</i>)	
	Disease incidence (%)	Reduction in disease incidence over control (%)	Disease incidence (%)	Reduction in disease incidence over control (%)
T ₁ -Garlic extract 1%	20.10	52.48	15.39	55.13
T ₂ -Neem oil 1%	15.70	62.88	12.26	64.25
T ₃ - <i>Calotropis gigantea</i> extract 10%	30.13	28.77	27.06	21.10
T ₄ - <i>Prosopis juliflora</i> extract 10%	34.60	18.20	28.73	16.23
T ₅ - Propiconazole 0.1%	7.030	83.38	7.03	79.50
T ₆ - <i>Pseudomonas fluorescens</i>	24.40	42.31	19.06	44.43
T ₇ - PPFM 1%	25.40	39.95	19.36	43.58
T ₈ - Control	42.30	-	34.30	-
LSD (P=0.05)	4.96	-	3.70	-

PPFM - Pink pigmented facultative methylotroph

Applications of plant extracts have shown significant reduction in the incidence of many diseases with corresponding increase in yield. Khan *et al.* (1996) observed that the leaf extracts from *Calotropis procera* and *Azadirachta indica* reduced the number of seed mycoflora on chickpea and increased their germination percentage. The fungicidal spectrum of neem has been thoroughly reviewed by Parveen and Alam (1993). Antifungal properties were also established by Ghewande (1989). Anonymous (2002) reported that garlic bulb extract can give better control against alternaria blight of sunflower

There was a maximum reduction in rust disease caused by *Puccinia helianthi* (79.5 %) in propiconazole 0.1% spray followed by neem oil (64.25%). However, the weed extracts namely *Calotropis gigantea* and *Prosopis juliflora* were able to suppress the disease to the tune of 21.1% and 16.2% PDI, respectively. The biocontrol agents PPFM recorded 43.58% and *Pseudomonas* recorded

44.43% reduction in PDI over control (Table 1). Anonymous (2006) reported that *P. juliflora* leaf extract was highly effective in inhibiting growth of rust disease. They have prepared a commercial product named 'Prosopan' out of toxic metabolite purified from *P. juliflora*. On the contrary, in the present study *P. juliflora* could inhibit 21.1% reduction in PDI over the control.

The results indicated that, spraying of propiconazole 0.1% registered the maximum yield of 1727 kg/ha. The extracts of *Calotropis gigantea* and *Prosopis juliflora* recorded 1307 kg/ha and 1148 kg/ha, respectively (Table 2). In recent years, use of plant products for the control of plant diseases is gaining importance (Anandaraj and Leela 1996). Thus the above results suggested that due to economical and ecological reasons, use of botanical extracts for control of plant diseases is desirable and may be encouraged.

Table 2. Effect of weed and plant extract on yield parameters of sunflower

Treatment	Height (cm)	Yield (kg/ha)	Increase in yield over control (%)
T ₁ - Garlic extract 1%	167.9	1409	37.10
T ₂ - Neem oil 1%	169.9	1647	38.70
T ₃ - <i>Calotropis gigantea</i> extract 10%	160.2	1307	32.13
T ₄ - <i>Prosopis juliflora</i> extract 10%	159.2	1148	22.73
T ₅ - Propiconazole 0.1%	175.3	1727	48.63
T ₆ - <i>Pseudomonas fluorescens</i> 1%	165.0	1615	37.31
T ₇ - Pink pigmented facultative methylotroph 1%	164.1	1382	35.81
T ₈ - Control	152.9	887	-
LSD (P=0.05)	3.6	127	-

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