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Effect of foliar application of herbicides, Benthiocarb, 2,4-D and Fluchloralin on phyllosphere microflora of potato

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Abstract

Three herbicides, Benthiocarb, 2,4-D and Fluchloralin were evaluated for their effect on leaf surface microflora of potato. In general, the application of herbicides resulted into a drop in the microbial population. Throughout the study herbicide treated leaves harboured less population compared to the untreated ones.

Introduction

Studies on microflora of leaf surfaces have received ample attention and a number of generalizations pertaining to the community structure of leaf surface microorganisms, their role as decomposer and as antagonists to plant pathogens have merged (Blakeman and Fokkema, 1981; Preece and Dickinson, 1971; 1976). Leaf surface microflora of potato has been investigated by a number of workers (Holloman, 1967; Sinha, 1971). A few studies have been conducted on the effect of herbicides on plant disease and it is reported that depending on the chemical composition and application-dose the herbicides may be stimulatory or inhibitory to the pathogen (Altman and Campbell, 1977; Hodges, 1982). However, no attempt has so far been made to study the effect of herbicides on the leaf surface microflora in general and potato in particular. It was, therefore, thought necessary to study the effect of herbicides on the leaf surface microflora of potato.

Materials and methods

The study was conducted in the farms of Central Potato Research Station (CPRS) Shillong (altitude 1706 M, latitude 25°34″N, Longitude 91°56″E). Disease free tubers were procured from the CPRS, Shillong. The crop was sown in the last week of March. A 30-m^2 plot was taken for each treatment and the control. The plots were randomized. The herbicides recommended for potato and commonly used by growers of this region were used. The chemical names, commercial names, recommended doses and manufactures of the herbicides were as follows: Benthiocarb, S(4-chlorobenzyl)-N, N′ diethyl thiocarbamate, Saturn, (3.01 ha^{-1}), Pesticides India, Udaipur; 2,4-D, 2,4-Dichlorophenoxy acetic acid, Weedone, (1.21 ha^{-1}), Agromore Ltd, Bangalore; Fluchloraline, N Propyl-N(2′chloroethyl)-2,6 dinitro-n-trifluromethyl aniline, Basaline, (1.71 ha^{-1}) BASF India Ltd, Bombay. Initial sampling for microbiological analysis was done 20 days after emergence of the plants and on the same day manufacturers recommended doses of the herbicides were sprayed. Subsequent samples were collected on 15 days interval. For each treatment five plants were collected from the field and five leaves of same vigour and age from each plant were used. To determine population of viable fungi and bacteria, leaf pieces were cut by a sharp sterilized cork borer of 5 mm diameter. 50 pieces were shaken in a 250-ml conical flask containing 100 ml of sterilized distilled water and serial dilutions were prepared. For enumeration of fungal and bacterial population 0.5 ml of appropriate dilution was

inoculated on sterilized petriplate containing 20 ml of Martin's rose bengal agar medium and Nutrient agar medium respectively (Johnson and Curl, 1972). Petriplates for fungi were incubated at 25°C for seven days and for bacteria at 30°C for 24 hours. The microbial population was calculated on the basis of per cm^2 area of the leaf.

Results and discussion

In case of bacteria the population decreased initially which was followed by a rapid increase in all the herbicide treated plants. In case of untreated ones the population increased steadily. Throughout the study period herbicide treated leaves harboured less population as compared to the control (Fig. 1). An initial drop in fungal population was observed in most herbicide treated leaves, however, recovery was noted 15 days after the spray and thereafter the popultion increased with time. Herbicides treated leaves harboured lower population as compared to the control ones. The three herbicides marginally differed in their net effect on the population. In the case of Benthiocarb the population did not decrease initially but the increase

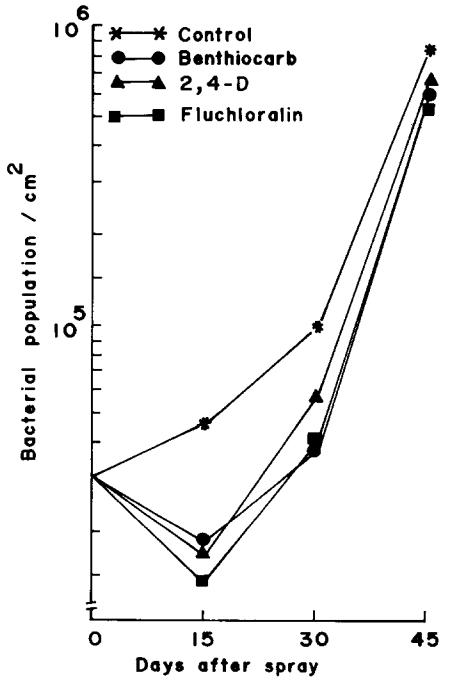

Fig. 1. Bacterial population of leaf surfaces of potato sprayed with herbicides.

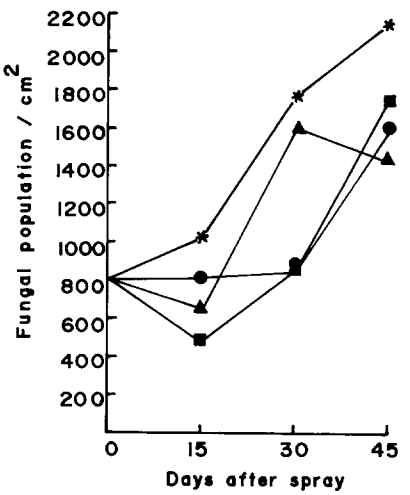

Fig. 2. Fungal population of leaf surfaces of potato sprayed with herbicides. *Symbols* as in Fig. 1.

was averted and population remained almost at the same level up to a period of 30 days after the spray. It appears the effect of the herbicide was persistent for a longer period (Fig. 2).

Table 1 lists the fungal species isolated from the phyllosphere of treated and control plants. *Penicillium brevicompactum* and *Fusarium oxysporum* were isolated only from untreated plants and *Oidiodendron echinulatum* was isolated only from the herbicide treated plants. *Arthrobotrys arthrobotryoides*, *Cladosporium cladosporioides*, *Mucor hiemalis*, *Mucor racemosus*, *Penicillium chrysogenum* and sterile forms were common to all the treated as well as untreated plants. Almost similar fungal flora was reported by other workers (Holloman, 1967; Sinha, 1971). The appearance of *O. echinulatum* on 30th day and its disappearance again at 45 days was an interesting observation (Table 1). May be, this fungus found more conducive habitat when the population of most other fungi diminished due to the effect of herbicides and again when the recolonization started it disappeared. It shows its resistance to the herbicides and also that it is probably a weak competitor on leaf surfaces.

Population and species composition of leaf surface microbial communities are governed by the Physico-chemical characteristics of the leaf surfaces (Cabral, 1985; Dickinson *et al.*, 1975). Under normal conditions microbial population on phyllosphere are held in a dynamic balance by interaction between the host plant and saprophytic microflora.

Table 1. Percentage abundance[a] and number of propagules of fungi at 0, 15, 30 and 45 days after treatment with herbicides. *Upper* values are percentage abundance and values *in brackets* are number of propagules per cm^2 of leaf.

Name of fungi	Control				Benthiocarb			2,4-D			Fluchloralin		
	0 days	15	35	45	15 days	30	45	15 days	30	45	15 days	30	45
Alternaria alternata	—	10 (102)	24 (408)	14 (306)	—	—	—	—	—	7 (102)	—	—	6 (102)
Arthrobotrys arthrobotryoides	—	—	—	23 (494)	—	—	31 (1529)	—	6 (100)	—	—	—	24 (408)
Cladosporium cladosporioides	34 (255)	20 (204)	15 (262)	23 (494)	—	—	—	23 (204)	—	35 (500)	—	25 (204)	—
Fusarium oxysporum	—	10 (102)	—	—	—	—	—	—	—	—	—	—	—
Mucor hiemalis	13 (98)	10 (102)	—	—	—	—	—	—	—	—	60 (306)	13 (102)	—
Mucor racemosus	10 (76)	10 (102)	—	—	50 (408)	—	—	—	—	—	—	—	—
Oidiodendron echinulatum	—	—	—	—	—	13 (102)	—	—	13 (207)	—	—	13 (102)	—
Penicillium brevicompactum	—	10 (102)	5 (97)	—	—	—	—	—	—	—	—	—	—
Pencicillium chrysogenum	—	20 (204)	10 (175)	14 (306)	—	13 (102)	—	33 (204)	—	29 (408)	—	—	24 (408)
Rhizopus oryzae	10 (76)	—	—	—	—	—	—	—	—	—	—	—	—
Rhizopus stolonifer	7 (54)	—	—	—	—	—	—	—	—	—	—	—	—
Sterile green	22 (165)	10 (102)	41 (713)	18 (387)	25 (204)	25 (204)	31 (1528)		43 (712)	28 (406)	40 (204)	30 (245)	12 (175)
Sterile white	4 (20)	—	5 (87)	8 (172)	25 (204)	49 (408)	38 (1630)	34 (207)	38 (611)	1 (14.5)	—	19 (155)	34 (589)

[a] Percentage abundance $= \frac{\text{No. of colonies of the fungi} \times 100}{\text{Total No. of colonies of all fungi}}$

Application of extraneous chemical modifies the leaf surface micro environment. The change may be detrimental to a number of microbes. Initial drop in the microbial population may be ascribed to this disturbance. Hodges (1982) has reported that herbicides modify the chemical nature and quantity of leaf exudates. This may also be responsible for the decrease in the fungal and bacterial population. During later periods the microbial population increased with time, which was in consonance with the untreated plants. Invariably the number of microorganisms increased with increasing leaf age (Sinha, 1971). It appears the effect of herbicides remain only for a short period and it diminishes slowly after 15 days and after about 45 days the microbial population on phyllosphere of herbicide treated plants becomes almost similar to that of the control ones. Steep reduction in the population of saprotrophs from the leaf surfaces for a period of fifteen days may make the plant more susceptible to the attack of pathogens due to removal of the saprophytic antagonists. Thus, herbicide spray may stimulate disease incidence, however, no study on this aspect is available.

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