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Weed Flora of Potato (*Solanum tuberosum*) and their Management in the Nilgiris

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ABSTRACT

A study was conducted during summer season of 2001 to 2004 with an objective to document the important weeds of potato crop in Nilgiris based on their importance value index. The data were collected on species-wise weed count, fresh weight, frequency of occurrence and canopy coverage on 45th day of potato planting. The results indicated that *Coronopus didymus* and *Polygonum nepalense* were the two major weeds of potato crop in Nilgiris hills. Weed management strategy for these weeds has been suggested.

Key words : Importance value index, weed flora, relative density, relative frequency, relative dominance

INTRODUCTION

Weed flora that competes with a particular crop species differs from location to location depending upon climatic, edaphic and management practices which are influenced by its geographical location. Identifying the major weeds of a crop enables the researcher to design sound weed management strategies. The Nilgiris district of Tamil Nadu, a part of Western Ghats range, represents a unique agro-climatic condition due to its geo-graphical location. The elevation of the district ranges between 1000 to 2500 m above MSL which falls under moist sub-humid group of climatic classification.

In Nilgiris, the mean annual rainfall received is 1300 mm under two monsoon seasons with a little higher share of 50-55% during south west monsoon. The mean maximum temperature ranges between 17.5 and 22.2^{0}C and the range of mean minimum temperature is between 7.3 and 12.3^{0}C. The soils of the region are characterized by low pH, high organic carbon and low available phosphorus. All these factors support the wild vegetation to be alive throughout the year, creating competition for the agricultural crops and hindering them to express their full yield potential.

In different locations, the loss in potato yield due to weeds ranges from 10 to 80% (Lal and Grewal, 1990) and even a loss of 10% accounts for an amount of 1.5 million tonnes of potatoes in our country (Dixit and Singh, 1999).

In Nilgiris, the weeds of potato have not been documented so far, which is very much essential in designing sound management practices for controlling them. Hence, an attempt was made to document the most important weeds of potato crop through their importance value and importance value index in relation to other species in the community.

MATERIALS AND METHODS

The species-wise weed count, fresh weight, frequency of occurrence and canopy coverage were collected on 45th day of potato planting using quadrat (one square metre size) method in farmers' fields at seven different locations (Muthorai, Nanjanad, Wood House, Doddabetta, Wellington, Coonoor and Kundah) having different elevation, soil type and management practices during summer seasons of 2001-02, 2002-03 and 2003-04. At each location, all these observations were collected for 30 quadrates. The average values were utilized in calculating importance value of each species and also importance value index.

$$\text{Importance value (\%)} = \frac{W_a}{W_t} \times 100$$

Where, W_a is the fresh weight of a species

W_t is the total fresh weight of all species in a given sample plot

In addition, to express the dominance and ecological success of any species with a single value only, the importance value index (IVI) was worked out.

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$$\text{1. Relative density (RDe)} = \frac{\text{Number of individuals of a species}}{\text{Total number of individuals}} \times 100$$

$$\text{2. Relative frequency (RF)} = \frac{\text{Frequency of a species}}{\text{Sum frequency of all species}} \times 100$$

Where,

$$\text{Frequency of a species} = \frac{\text{Number of quadrats of occurrence of a species}}{\text{Total number of quadrats}}$$

$$\text{3. Relative dominance (RDo)} = \frac{\text{Dominance of a species}}{\text{Dominance of all species}} \times 100$$

Where,

$$\text{Dominance of a species} = \frac{\text{Canopy cover of each species}}{\text{Total sample area}} \times 100$$

Then,

$$\text{IVI} = \frac{\text{Rde+RF+RDo}}{3}$$

Table 1. Weed flora of potato in Nilgiris based on importance value

S. No.	Name of weed species	Weed count/m^2	Fresh weight (g) of each species	Importance value (%)
1.	*Polygonum nepalense*	7.13	19.46	28.30
2.	*Coronopus didymus*	9.72	13.90	20.21
3.	*Spergula arvensis*	3.15	7.95	11.56
4.	*Gallinsoga parviflora*	2.47	7.01	10.19
5.	*Eragrostis tenuifolia*	1.86	4.35	6.33
6.	*Helichrysum bracteatum*	0.41	3.00	4.36
7.	*Emilia scabra*	0.53	2.98	4.33
8.	*Oxalis pubescens*	1.72	1.81	2.63
9.	*Kyllinga cylindrical*	0.52	1.79	2.60
10.	*Bidens pilosa*	0.51	1.76	2.56
11.	*Stellaria media*	0.43	1.39	2.02
12.	*Gynura nitida*	0.14	0.94	1.37
13.	*Gnaphalium polycaulon*	0.16	0.70	1.02
14.	*Setaria pumila*	0.35	0.58	0.84
15.	*Notonia walkeri*	0.10	0.41	0.60
16.	*Chenopodium album*	0.27	0.28	0.41
17.	*Silene gallica*	0.29	0.28	0.41
18.	*Veronica agrestis*	0.16	0.16	0.23
19.	*Brassica juncea*	0.06	0.01	0.01
20.	*Satureja umbrosa*	0.03	0.003	0.004

RESULTS AND DISCUSSION

Importance Value

Using fresh weight of standing biomass, the importance value of each species was calculated for all the important weeds of potato crop. Based on importance value, the species were ranked expressing their dominance over other species (Table 1). Among the 20 weed species observed in potato fields at different locations, the importance value of *Polygonum nepalense* is very high in comparison with all others indicating that it produces a very good amount of biomass very quickly. Being a quick grower, it occupies the area faster and spreads very fast. This is closely followed by *Coronopus didymus* which covers the ground like a thick mat. The third position is occupied by *Spergula arvensis* a small herb.

Importance Value Index (IVI)

Weed species were ranked based on their IVI value with respect to potato crop (Table 2). The ranking of species differed very slightly especially with respect to most dominant weed i. e. the weed occupying first

Table 2. Weed flora of potato in Nilgiris based on importance value index (IVI)

S. No.	Name of weed species	Relative density (RD)	Relative frequency (RF)	Relative domiance (RDo)	IVI
1.	*Coronopus didymus*	32.41	6.51	41.50	26.81
2.	*Polygonum nepalense*	23.78	6.51	25.84	18.71
3.	*Spergula arvensis*	10.49	6.51	4.69	7.23
4.	*Gallinsoga parviflora*	8.24	4.36	8.17	6.92
5.	*Eragrostis tenuifolia*	6.20	6.51	3.35	5.35
6.	*Oxalis pubescens*	5.72	6.51	3.61	5.28
7.	*Bidens pilosa*	1.71	6.51	2.41	3.54
8.	*Kyllinga cylindrica*	1.72	6.51	0.94	3.06
9.	*Stellaria media*	1.44	6.51	0.80	2.92
10.	*Emilia scabra*	1.76	4.36	2.41	2.84
11.	*Gnaphalium polycaulon*	0.52	6.51	0.87	2.63
12.	*Helichrysum bracteatum*	1.36	4.36	1.47	2.40
13.	*Setaria pumila*	1.16	4.36	0.80	2.11
14.	*Silene gallica*	0.95	4.36	0.67	1.99
15.	*Gynura nitida*	0.48	4.36	0.67	1.84
16.	*Veronica agrestis*	0.54	4.36	0.40	1.77
17.	*Notonia walkeri*	0.32	4.36	0.33	1.67
18.	*Chenopodium album*	0.90	2.15	0.80	1.28
19.	*Brassica juncea*	0.19	2.15	0.27	0.87
20.	*Satureja umbrosa*	0.11	2.15	-	0.75

position in potato field. Highest importance value index was recorded by *C. didymus* and the highest importance value was recorded against *P. nepalense*. Hence, these two weeds can be ranked as the most obnoxious for potato cultivation followed by *Spergula arvensis*, in Nilgiris. The values for number of individuals and canopy coverage which are represented by relative density and relative dominance, respectively, are higher in case of *C. didymus*, which is capable of spreading very fast by covering the ground area like a thick mat. Although the weed species viz., *C. didymus*, *P. nepalense* and *S. arvensis* had the same frequency of occurrence with respect to potato fields are concerned, their density and canopy cover differed significantly making *C. didymus* and *P. nepalense* more important weeds. All these weeds are observed to be present in all the vegetable crops of Nilgiris viz., potato, cabbage, carrot, beet root, cauliflower, etc. and the mode of propagation of all these weeds is mainly through seeds except for *Kyllinga cylindrica*, which is propagated by rhizomes.

In addition to above, kikuya grass (*Pennisetum clandestinum*) and crow foot grass (*Dactyloctenium aegyptium*) can be seen abundantly especially on field bunds and waste places. Wild radish (*Raphanus raphanistrum*) and lupin (*Lupinus angustifolius*) can also be noticed whenever these crops were grown during previous crop seasons.

Factors Affecting Composition of Weed Flora

Among the different weed species that were found in different locations, there were differences in the species composition from location to location. At higher elevations of about >2000 m above MSL, mostly the broad leaved weeds were predominant and conversely at lower elevations i. e. <1500 m above MSL graminaceous weeds like *Kyllinga*, *Eragrostis*, *Setaria*, etc. were more dominant. The preference of these species for different locations could also be due to differences in soil reaction and mean daily temperature. The soils are more acidic in reaction (pH range : 3.5 to 4.2) at higher elevations where the mean temperature remained lower. In lower elevations, the mean temperatures are relatively higher and the soils are less acidic (pH range : 4.5 to 5.5) in reaction.

Control Measures

In potato crop, adoption of wider spacing, liberal use of manures and fertilizers and frequent rains associated with high organic carbon containing fertile soils of Nilgiris favour early growth of weeds. These weeds emerge well before potato's emergence and grow faster at early stages due to lack of competition from the crop. This causes a heavy reduction in crop yields (upto 10-80%) as the weeds drain away all the nutrients applied to the crop. The critical period of weed competition in potato in Nilgiris is first 6-8 weeks after planting and the crop should be well protected from weeds at this stage by creating weed free environment.

Cultural methods : In Nilgiri hills, potato is grown in very narrow terraces of width ranging between 2 to 4 m. Hence, use of animal or mechanical power is not advisable for controlling weeds in this area. At early stages of crop growth, manually operated weeder can be used to kill the weeds in between potato rows. For effective control of weeds two manual weedings are to be adopted at 30 and 45 days after planting with the help of hand hoes, which not only removes the weeds but also loosens the soil in order to improve the infiltration capacity of the soil to retain more moisture from rains and to help in better penetration of root system of potato plants. Deep ploughing can be practised during February/ March when there is no crop in the field, which exposes all the weed seeds to hot sun and many of them may loose their viability.

Chemical methods : Chemical methods of weed control are more economical, less labour consuming and also effective if practised with due care. Many herbicides have been tested and found effective against weeds of potato crop. Among them, pre-planting herbicides like fluchloralin (0.7-1.0 kg/ha) or pendimethalin (1.0 kg/ha) can be applied before planting of potato and thoroughly mixed with the soil to avoid volatalization losses. The pre-emergence application of herbicides like alachlor (1.5-2.0 kg/ha), 2, 4-D (0.5 kg/ ha), atrazine (0.5 kg/ha) and metribuzin (0.7-1.0 kg/ha) can be applied within 3-5 days after planting the crop or just before the emergence of weeds and the crop. Post emergence herbicide paraquat (0.5 kg/ha) can be applied after 4-5% emergence of potato crop.

Integrated weed Management : By judiciously combining all the feasible methods of weed control, the weed infestation can be brought down to the economic threshold level. In Nilgiris, keeping the land covered with crop for most part of the year, deep ploughing in February-March, practising suitable crop rotation, keeping the bunds and channels clean and combined use of chemical and cultural methods of weed control can reduce the weeds in potato field to a considerable extent thereby avoiding the losses due to weed menace.

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