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SEED BANK OF SUMMER WEEDS IN WHEAT FIELDS OF DIFFERENT RAINFALL ZONES OF PUNJAB, PAKISTAN

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Abstract

The soil seed reserves of different summer weeds were studied in the fields of different rainfall zones of Punjab, Pakistan. Composite soil samples collected from fields comprising of very low (150-300 mm), low (300-500 mm), medium, (500-1000 mm) and high (1000-1500 mm) annual rainfall areas were kept in trays of uniform size in the green house at National Agricultural Research Centre, Islamabad. An environmental condition was provided for germination of weed seeds. Seedlings emerging over a period of three years were identified, recorded and removed at intervals. The seed reserves of different zones differed from each other in terms of weed seed composition, seed number by species and total number of seeds in the soil. The species diversity and number of seeds in the soil remained lowest in very low rainfall area. With the increase in annual rainfall, both the parameters also increased with highest values in the high annual rainfall area.

Introduction

The seeds produced by flowering plants may germinate as soon as conditions become favourable or may remain dormant in the soil for an indefinite period. In the later case they become incorporated into the seed bank that may represent an accumulation of seeds of many years and can range from few hundreds to thousands per sq. m. in the upper 10-15 cm layer of soil (Roberts & Chancellor, 1986; Roberts & Neilson, 1982; Forcella & Lindstrom, 1988). The size and species composition of the seed bank can be used to predict the weed flora composition of a particular area which might infest the crop in coming years (Wilson *et al.*, 1985). Therefore, the planning of weed management programmes may also be based on the information regarding the weed seed bank of that particular area.

Winter crop is mainly cultivated in the rainfed areas of the Punjab Pakistan which is mostly followed by maize, ground-nut and sunflower during the summer season. A study was conducted to evaluate the extent and nature of weed problem of the summer crops and to examine the impact of rainfall on the floral composition and the soil seed bank since moisture availability is one of the important factors which affects the floral composition and the success of a particular species to get established in a particular area (Rahman & Rutter, 1980; Kloot, 1980; Robert *et al.*, 1988; Naeem, 1993).

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Table 1. Categorization of zones on the basis of rainfall.

Zone	Annual rainfall (mm)	Moisture Status/Climate	Major Cities/Towns
I	150-300	Very low/arid/very hot	Mianwali, Bhakkar
II	300-500	Low/semi-arid/hot	Talagang, Fatehjang
III	500-1000	Medium/sub-humid/moderate	Rawalpindi/Islamabad
IV	1000-1500	High/humid/cold	Trait/Murree

Materials and Methods

The northern areas of the Punjab, Pakistan where wheat (*Triticum aestivum* L.) is grown under rainfed conditions during October to April was selected for the study. On the basis of the annual rainfall, four zone were selected (Table 1). In every rainfall zone three sites were selected from which three adjacent fields were identified for the study.

In December, 1986, soil samples from 15 cm surface were collected from 36 fields of 12 different sites using on 10 cm diam., auger The soil samples were collected from each field in such a way that the border and the centre were both covered according to the procedure described by Saleem *et al.*, (1983). The composite samples for each field were brought to the laboratory where they were reduced to the required size by quartering method as described by Govinda & Gopala (1971). A part of each composite sample was separately spread in a uniform layer of approximately 7 cm depth in trays of 45x38 cm. The trays were kept in the green house of National Agricultural Research Centre, Islamabad at a temperature of 25-26°C and 78% R.H with temperature fluctuation towards lower side during winter and higher side during summer. From January 1987 onward the soil was kept moist using the procedure as described by Roberts & Neilson (1982) and Roberts & Chancellor (1986) so that all the viable seeds could germinate. The soil was stirred periodically to facilitate the germination of the seeds of deeper layers. The seedlings emerging over a period of three years from January 1987 to December 1990 were counted, identified and removed from the trays to allow space for the other viable seeds to germinate. At the end of third year none of the tray had any germinated seedling. Identification of the weed seedlings were carried out at the National Herbarium, National Agricultural Research Centre, Islamabad after reference to the Flora of Pakistan (Stewart, 1972; Nasir & Ali, 1970-1991).

Results and Discussion

During a 3 years study period, 42 broadleaf weed species of the summer season were identified from soil collected from different rainfall zone (Table 2). Of these, seven weed species emerged in zone I with *Euphorbia prostrata* having the largest seed reserves of 111 seeds out of soil seed bank of 140 viable seeds of different broadleaf weeds of the summer season. *E. prostrata* again showed the highest seed number in Zone II and III (170 seeds). The total number of seedlings of different weeds emerging in zone II were 264 (Table 2). In zone IV, out of a total of 1593 seedlings, 28 broadleaf

Table 2. Seeds* of broad leaf Kharif weeds (summer) found in the soil of wheat fields of different rainfall zones of rainfed area (Punjab, Pakistan).

	Zone I	Zone II	Zone III	Zone IV
Ajuga bracteosa	--	4	--	--
Alternanthera pungens	1	--	--	--
Amaranthus hybridus	--	--	4	76
Amaranthus viridis	--	--	--	1
Caryophyllaceae sp.	--	--	--	2
Celosia argentea	--	--	14	18
Cerastium cerastioides	--	--	1	70
Cerastium glomeratum	--	--	--	10
Commelina benghalensis	--	--	--	104
Conyza canadensis	--	--	--	2
Corchorus aestuans	--	--	--	3
Datura innoxia	--	--	--	2
Descurainea sophia	--	--	5	--
Digera muricata	--	17	42	--
Eclipta prostrata	--	--	--	15
Euphorbia hirta	--	--	--	6
Euphorbia indica	--	--	2	--
Euphorbia prostrata	111	170	260	350
Filago pyramidata	1	--	--	--
Galinsoga parviflora	--	--	--	4
Gisekia pharnaceoides	2	--	--	--
Heliotropium europaeum	20	57	1	--
Ifloga spicata	3	--	--	--
Ipomoea hederacea	--	1	2	7
Ipomoea hispida	--	--	1	--
Justicia simplex	--	--	3	274
Lathyrus sphaericus	--	--	--	1
Launaea procumbens	--	2	--	--
Mazus pumilus	--	--	--	5
Oenothera rosea	--	--	--	8
Oldenlandia corymbosa	--	--	2	157
Oxalis corniculata	--	11	2	3
Papavar dubium	--	--	6	15
Papavar hybridum	--	--	--	1
Papavar Pavonium	--	--	1	--
Portulaca oleracea	--	--	20	368
Prunella vulgaris	--	--	--	19
Pupalia lappacea	--	--	--	2
Ranunculus sceleratus	--	--	10	--
Sesbania sesban	--	2	6	61
Sisymbrium irio	2	--	--	--
Sphenoclea zeylenica	--	--	3	9

*Each figure is a sum of three years' data.

weed seedlings were identified where *Portulaca oleracea* showed the largest viable soil seed reserves of 368 seedlings (Table 2).

Atleast 26 different species of the seeds of sedges and grasses of summer season were found in the soil samples of different rainfall zones. *Poa annua* showed the largest soil seed reserves of 100 seedlings out of 8 weed species which emerged with a total seed strength of 205 in Zone I (Table 3). Largest seed reserves of *Eleusine indica* with 41 seedlings was found in Zone II out of a total strength of 248 seeds of 13 weed species. *Poa annua* again showed the largest seed reserve in Zone III and IV in the soil with 819 seedlings emerging during the study period out of a total of 4049 comprising of 25 weed species.

Total strength of soil seed reserves and species number progressively increased with the increase in annual rainfall (Table 2,3). Both the parameters i.e., seed number and species number was quite high in zone IV. Such results have already been reported

Table 3. Seeds@ of sedges and grasses of Kharif (summer) found in the soil of wheat fields of different rainfall zones of rainfed area (Punjab, Pakistan).

	Zone I	Zone II	Zone III	Zone IV
Acrachne racemosa	--	--	2	116
Brachiaria deflexa	--	--	--	127
Brachiaria ramosa	13	30	71	109
**Cynodon dactylon*	--	5	3	3
Cyperus alulatus	--	--	1	--
Cyperus difformis	--	--	--	13
Cyperus iria	--	2	2	2
**Cyperus rotundus*	3	8	186	300
Dactyloctenium aegyptium	22	25	60	347
Digitanria longiflora	--	1	36	710
Digitaria setigera	--	25	30	63
Digitaria stricta	--	--	--	2
Digitaria violascens	--	--	--	194
Echinochloa colonum	26	39	154	376
Eleusine indica	3	41	57	490
Eragrostis ciliaris	10	12	6	7
Fimbristylis ferruginea	--	--	2	113
Juncus bufonius	--	--	4	130
Octhochloa compressa	--	--	--	1
Paspalum paspaloides	--	--	2	34
Phleum paniculatum	--	--	--	28
Poa annua	100	40	541	819
Polypogon monspeliensis	--	--	47	28
Rostraria cristata	--	1	1	7
Setaria pumila	--	--	--	4
**Sorghum halepense*	28	19	8	26

@Each figure is a sum of three years' data.
*Perennial weeds.

by Naeem *et al.*, (1993) where the same pattern of distribution was observed by weeds. Similarly, in a study by Kloot (1980), floral composition was found correlated with annual rainfall. In another study, Numata (1991) assumed, on the basis of a survey, that the moisture status was one of the causal factor for the differences found in the weed flora at different sites. Similarly, Collinson (1977), specifically held the moisture availability as responsible for the complexity and the assemblage of species.

Amongst the broadleaf weeds *Euphorbia prostrata* was the only species which showed its seeds in all the four rainfall zones (Table 2). In case of sedges and grasses (Table 3), *Brachiaria ramosa, Cyperus rotundus, Dactyloctenium aegyptium, Echinochloa colonum, Eleusine indica, Eragrostis ciliaris, Poa annua* and *Sorghum halepense* showed a wide range of distribution with their seedlings emerging in the soil samples of all the four rainfall zones, though the number of seedlings was much higher in zone IV. Except *Poa annua* which showed the lowest seed reserves in zone II, the rest of all common species showed a progressive increase with an increase in the annual rainfall. This is quite in accordance with the study made by Trivedi & Tripathi (1982) who found *Spergula arvensis* producing less capsules per plant under water stress, with highest number of seeds per capsule when the plants were watered daily. The wide distribution of these weeds can be ascribed to their potential to germinate over a wide range of moisture as found in *Parthenium hysterophorus*, where temperature was the detrimental factor for its wide distribution (Williams & Groves, 1980). The present study confirms the results of previous reports which reveal that moisture availability can affect the growth of a particular species, its reproductive capacity, its distribution over a moisture gradient and the floral composition at a particular area (Marks, 1983; Wilson, 1985; Robert *et al.*, 1988; Leguizaman, 1986; Roberts & Pottar, 1980; Terasawa *et al.*, 1981; Rahman & Rutter, 1980; Milijic, 1987). At the same time, the present study also predicts a threat of quite a complex floral composition of weeds with a wide range of species in the rainfed area of the Punjab which has previously been considered less important as far as the weed management programme is concerned (Report of the Punjab Barani Commission, 1976). There is therefore, need to study the extent of weed problem in rainfed area and in those areas where due to sufficient annual rainfall summer crop is also sown.

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