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Research

Weed species composition and growth in wheat field of mountain ecosystem Khokana, Lalitpur, Nepal

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Abstract

A study was carried out to determine the composition and predominance of weed species in wheat field in Khokana of Kathmandu valley as a representative sample of mountain ecosystem in Nepal. A total of 44 weed species representing 18 families were recorded. The most abundant species were *Chenopodium album*, *Polygonum plebeium* and *Spergula arvensis*. With the improved temperature after February, the weeds flourished in the late winter which had deterrent effect on the growth of wheat. Weeding practice was not much followed, while the fallowing gave more chances to weed species to germinate and grow. Periodic surveys on weeds help catalogue the existing weeds and extent of harm caused by them.

Key-words: Rice-wheat cropping practice, weed ecology, weed management.

Introduction

Wheat stands as the most important cereal crop after rice in Nepal, where rice-wheat cropping has been a popular farming practice. Of the total cultivated area in the country (2,968,000 ha), rice is cultivated in 1,544,990 ha and wheat in 669,014 ha. Eighty four per cent of the wheat cultivation area falls under rice-wheat rotational system (Singh and Paroda 1994). However, such type of rotational cropping has led to loss in yield of wheat (Joshi 1996). Nevertheless, the grassy weeds are also equally blamed for wheat yield (Aslam *et al*. 1989). An understanding of loss caused particularly by weeds, therefore, is important to explore successful approaches for preventing or minimizing such yield losses.

Those plants which usually grow where they are not wanted, and usually, interfere with the production of cultivated crops are considered to be weeds (Ranjit and Bhattarai 1988). Weeds are often defined as 'plants out of place', but this only considers the human view of a weed, not the fact that weeds are plants, which are ecologically in place, they are growing in an environment provided or managed by man which suits their needs. Weeds possess special plasticity in growth, which allows adaptation to varying conditions and very fast growth rates that give them advantages over crop (FAO 1987). Weeds reduce the crop yield either by reducing the amount of harvestable product (grain, stover, forage) or by reducing the amount of crop actually harvested (Aldrich 1984). The energy expended for the weeding of man's crops is sometimes more than for any other single human task (Holm 1971).

On account of the diverse climate, various intricate cropping systems are practiced in Nepal. Rice-based cropping systems are predominant in the lowland area of Nepal. As per the preliminary estimate of fiscal year 2005/2006, in lowlands of Nepal, under rice-wheat cropping system and out of total land under cultivation, wheat is cultivated on 381,243 ha with annual yield of 481,790 tons and productivity of 1.26 t/ha (CBS 1995).

The variegated geo-physical conditions in Nepal have created a hospitable environment for diversely adapted weed-flora. There is a chronic problem of loss in crop yield due to

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weeds in agricultural land. The long persisting menace of weeds has still remained in spite of several revolutionary break-through in modern weed-control science and technology. Under the existing farming and gardening system, which in most of the cases are tradition bound, the various factors that cause serious infestation of weeds are such as half-hearted or neglected approach towards weed control, prevalence of mono-culture system thus facilitating vigorous multiplication and perennation of weeds, lack of provision for scientific cropping pattern, fragmentation of holding, use of input materials unrestrictedly contained with weed seeds and so on (Regmi 1999).

The present study was conducted with an objective to determine the composition and predominance of weed species in wheat field in mountain ecosystem of Nepal.

Materials and Methods

STUDY AREA

The study was carried out in the wheat farm in Khokana village (location: 27° 38' N latitude and 85° 18' E longitude) in Kathmandu valley, Lalitpur, Nepal. The study site is at the altitude of about 1325 m asl and is mainly an agriculture dominated landscape. Study of weed flora was conducted during wheat cropping season, i.e. January to April 2006.

SAMPLING AND DATA COLLECTION

Three different plots were selected and named as Plot P, Plot Q and Plot R. For each plot, five permanent quadrats were laid down, four at corner and one at the center. Altogether 15 quadrats of 1 x 1 m^2 were laid down for study in three different plots of the field.

Data were collected once after every two weeks for first two months starting from January and then once a week for last two months ending April during wheat cropping period. During the field visit, percentage cover, tallest height of the species and state of the plant species was recorded. Frequency, relative frequency and frequency class of the species appearing at different plots was determined.

Weed samples were collected from different plots of the study area. Collected specimen was tagged; important characters of weed, date of collection, collection site and its local name (as far as possible) were noted. All specimens were preserved and later identified using standard literature.

Results and Discussion

SPECIES RICHNESS

A total of 44 weed species (incl. 4 unidentified) belonging to 18 families was recorded (Appendix 1). Among the three plots, the number did not vary much with 33 in plot P, 32 in plot Q and 37 in plot R. Weed coverage was found maximum in plot Q. This could be due to the reason that the field had good irrigation, while weeding practice was very less frequent and partially decomposed cow-dung was also used as fertilizer which might contain viable weed seeds.

The most dominant species on the basis of abundance scale in the study site were *Chenopodium album*, *Eclipta prostrata*, *Spergula arvensis* and *Polygonum plebeium*. Altogether, 4 dominant species, 9 frequent species and 21 occasional species and 10 rare species were reported. Family Compositae presented highest number of species (10 species), followed by Graminae (5). Study had been carried out in different plots with different microclimate; some plots were in shade and some were under sun throughout the day; some plots were relatively dry and some were overwhelmed with irrigated water. This could be the reason that a dominant weed in one plot becomes co-dominant or frequent in other plots.

Rajbhandari and Joshi (1998) have reported 208 weed species found in wheat fields of various geographic regions of Nepal, which constituted 57.1% of the total in the list prepared. Chaudhary (1979) reported 108 angiospermic weeds (14 monocots and 94 dicots) belonging to 36 families from six different sites of Kathmandu valley, viz. Thankot, Khumaltar, Dharmasthali, Indrayani, Bhaktapur and Kirtipur. The largest number of weed species belonged to Compositae followed by Graminae. Among the species, *Chenopodium album*, *Polygonum* sp., *Vicia* sp., *Cannabis sativa* were reported to the most abundant, which were all but one (*Vicia* sp.) were also found in the present study. However, the dominantly occurring species in the present study, *S. arvensis*, has been reported by Rajbhandari and Joshi (1998) in rape fields.

SPECIES EMERGENCE AND COVERAGE

In the first week of observation, at least four weed species appeared which reached to the maximum of 12 in plots P and Q in the seventh and sixth week, respectively; while the number reached 14 in plot R in the fifth week (Fig. 1). The limitation of species number after some period can be attributed to the competition for resources and to the smaller size of the

Table 1. Frequency, frequency class, relative frequency and cover-abundance scale of different species in Plot P.

Species	Frequency %	Frequency class	Relative frequency %	Cover-abundance scale
Spergula arvensis	100	E	6.57	5
Stellaria media	100	E	6.57	3
Lathyrus sativus	60	C	3.94	2
Polygonum plebeium	100	E	6.57	5
Persicaria sp.	40	B	2.63	+
Chenopodium album	100	E	6.57	1
Blumea lacera	80	D	5.26	1
Eclipta prostrata	100	E	6.57	2
Sida rhombifolia	20	A	1.31	3
Vernonia cinera	40	B	2.63	3
Kyllinga brevifolia	20	A	1.31	2
Tridax procumbens	40	B	2.63	2
Bidens sp.	40	B	2.63	+
Gnaphalium affine	20	A	1.31	1
Unidentified	20	A	1.31	+
Sporobolus indicus	60	C	3.94	1
Conyza stricta	20	A	1.31	2
Dichrocephala benthami	40	B	2.63	2
Plantago erosa	40	B	2.63	3
Unidentified	20	A	1.31	+
Trifolium repens	40	B	2.63	3
Cyperus difformis	20	A	1.31	2
Polygonum hydropiper	20	A	1.31	3
Unknown	40	B	2.63	R
Emilia sonchifolia	20	A	1.31	2
Unidentified	20	A	1.31	+

Note: Cover-abundance scale: 5 - dominant, 4 - co-dominant, 3 - frequent, 2 - occasional, 1 - numerous up to 5% cover, + - few with small cover, R – solitary with small cover (Braun-Blanquet 1932).

Frequency class based on Raunkiaer (1934).

quadrat studied, though in totality the number of species reached 44 as mentioned above. In lowland wheat field of Birgunj, Dangol (1987) recorded a total of 35 species.

The coverage development corresponded with the species emergence as it reached maximum in the sixth week, except in the Plot R where the farmers had weeding removing almost all the weeds in the sixth week (Fig. 2). The development of weed coverage directly corresponded and/or influenced the wheat coverage, as when there was higher weed coverage the wheat coverage was lower (Fig. 3). For instance, in plot Q some 80% of weed coverage was recorded, which contained less than 10% of wheat seedlings during the early season. This indicated a deterrent effect of weed growth in wheat production as the weeds compete for nutrients, water, light and space. Generally an increase in one kilogram of weed growth corresponds to reduction in one kilogram of crop grown (Rajbhandari and Joshi 1998).

The maximum temperature in the month of January was below 25^{0}C and minimum went below minus 3^{0}C in the year of study. The temperature increased gradually in the following months; in April the maximum temperature crossed 30^{0}C while the minimum did not go below 5^{0}C. The westerly also brought some rain in the late winter (March and April). Thus, the later part of the winter, that is, after February, was favorable for the vegetation to flourish.

Tables 1, 2 and 3 presents the frequency (%), frequency class, relative frequency (%) and cover abundance scale of each species in the three studied plots. Altogether 3 weed species, such as *Chenopodium album*, *Polygonum plebeium*, and *Spergula arvensis* qualified the frequency class E and cover-abundance scale 5 with frequency 100% in all three plots P, Q and R. Their relative frequency was above 5.0%. Similarly, some 8 weeds such as *Blumea lacera, Kyllinga brevifolia*, *Gnaphalium affine*, *Sida rhombifolia*, *Sporobolus*

Table 2. Frequency, frequency class, relative frequency and cover-abundance scale of different species in Plot Q.

Species	Frequency %	Frequency class	Relative frequency %	Cover-abundance scale
Spergula arvensis	100	E	5.95	5
Polygonum plebeium	100	E	5.95	5
Cannabis sativa	20	A	1.19	3
Plantago erosa	40	B	2.38	2
Chenopodium album	100	E	5.95	2
Gnaphalium affine	40	B	2.38	1
Trifolium repens	80	D	4.76	2
Bidens sp.	40	B	2.38	+
Unidentified	100	E	5.95	+
Juncus concinnus	40	B	2.38	+
Kyllinga brevifolia	80	D	4.76	1
Vernonia cinerea	100	E	5.95	2
Dichrocephala benthami	40	B	2.38	R
Polygonum hydropiper	20	A	1.19	R
Blumea lacera	80	D	4.76	1
Centella asiatica	20	A	1.19	1
Vernonica anagalis	40	B	2.38	2
Sida rhombifolia	40	B	2.38	+
Viola pilosa	20	A	1.19	+
Ranunculus scleratus	40	B	2.38	R
Sporobolus indicus	20	A	1.19	+
Emilia sonchifolia	20	A	1.19	1
Convulvulus sp.	20	A	1.19	1
Sacciolepis indica	20	A	1.19	+

Table 3. Frequency, frequency class, relative frequency and cover-abundance scale of different species in Plot R.

Species	Frequency %	Frequency class	Relative frequency %	Cover-abundance scale
Cannabis sativa	100	E	4.54	3
Chenopodium album	100	E	4.54	2
Polygonum plebeium	100	E	4.54	4
Spergula arvensis	100	E	4.54	2
Trifolium repens	100	E	4.54	1
Plantago erosa	80	D	3.63	1
Sacciolepis indica	20	A	0.9	+
Stellaria media	60	C	2.72	1
Blumea lacera	100	E	4.54	2
Gnaphalium affine	80	D	3.63	+
Sida rhombifolia	80	D	3.63	+
Viola pilosa	40	B	1.81	2
Dichrocephala benthami	80	D	3.63	1
Cynodon dactylon	100	E	4.54	1
Ranunculus scleratus	20	A	0.9	R
Centella asiatica	40	B	1.81	R
Unidentified	80	D	3.63	+
Unidentified	20	A	0.9	1
Unidentified	20	A	0.9	+
Sporobolus indicus	80	D	3.63	1
Bidens sp.	20	A	0.9	1
Convulvulus sp.	60	C	2.72	1
Unidentified	40	B	1.81	2

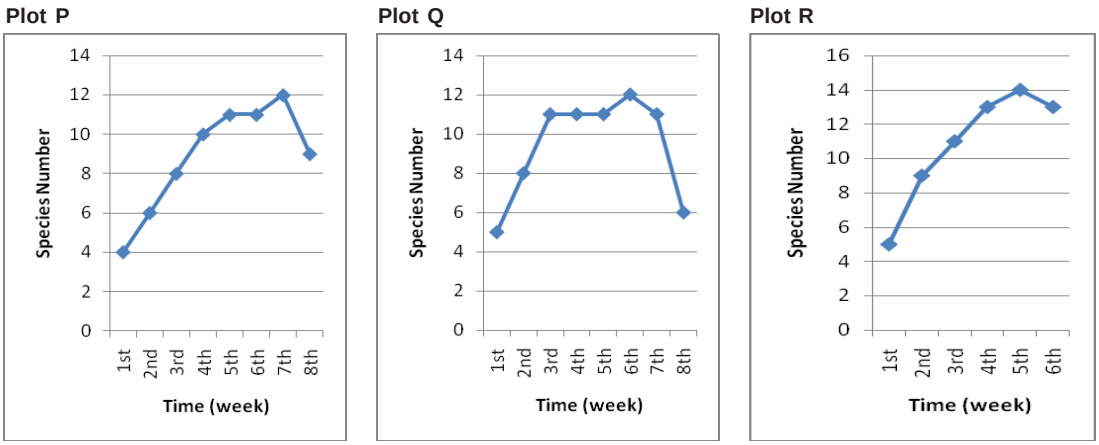

Figure 1. Species emergence in three study plots: P, Q and R.

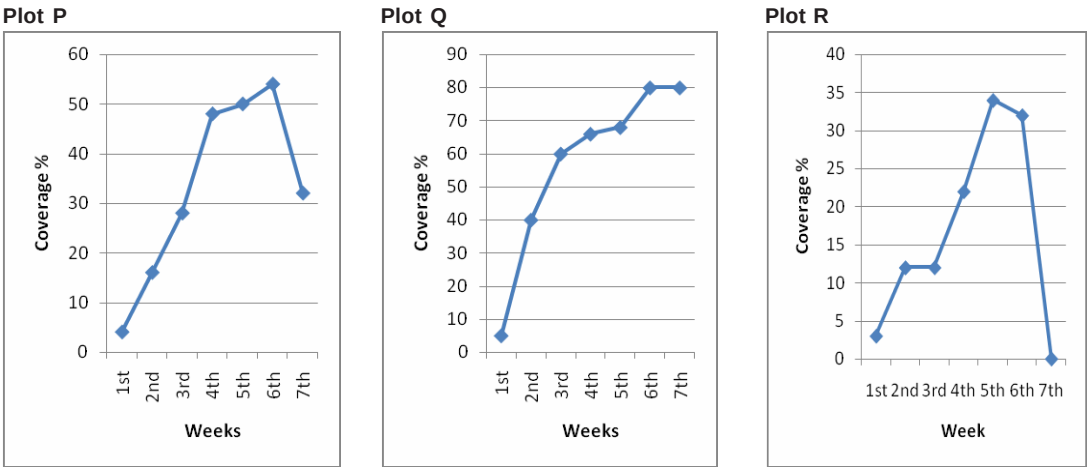

Figure 2. Coverage of weed in three study plots: P, Q and R.

indicus qualified for frequency class D with frequency of 80%, though some of them varied in one plot or other.

In a study carried out in the wheat fields of mid-hill district Kabhre in central Nepal, Joshi and Gretzmacher (1999) recorded a maximum of 64 weeds, out of which 10 species were dominant and 20 were co-dominant. The authors also recorded higher number of weed species in wheat fields compared to that of rice fields in the same area. In the present study, two species out of 26 species (7.7%) were dominant in Plot P, and two species out of 24 (8.3%) in Plot Q were dominant with cover-abundance scale of 5, while no such dominant species was recorded in the Plot R. Most of the species in the plots were occasional or less so with cover-abundance scale of 2 or 1 (Tables 1, 2 and 3). Such occurrence scale varied with different species in different plots. Similarly, the relative frequency of the species varied from 6.57% (e.g., *S. arvensis* in Plot P) to 0.9% (e.g. *Bidens* sp. in Plot R). This requires further investigation to understand the resource partitioning and/or competitiveness among the species.

It was noted from the observation in the field study that the farming practice was most responsible for the emergence of a wide variety of weeds. Weeding practice was found low or irregular and the cattle were allowed to graze freely. In plot Q, a massive weeding was observed in the seventh week, where the weed coverage abruptly decreased to almost zero (Fig. 2). However, such weeding is not regular. Nepali farmers usually do not weed out wheat fields and the degree of succession of weeds in their fields becomes invariably cumulative year after year (Joshi and Gretzmacher 1999).

Also, crop-rotation practice was found disregarded by the farmers in the site. Fallowing is considered to be a useful practice for nutrient recycling but during fallowing, weeds

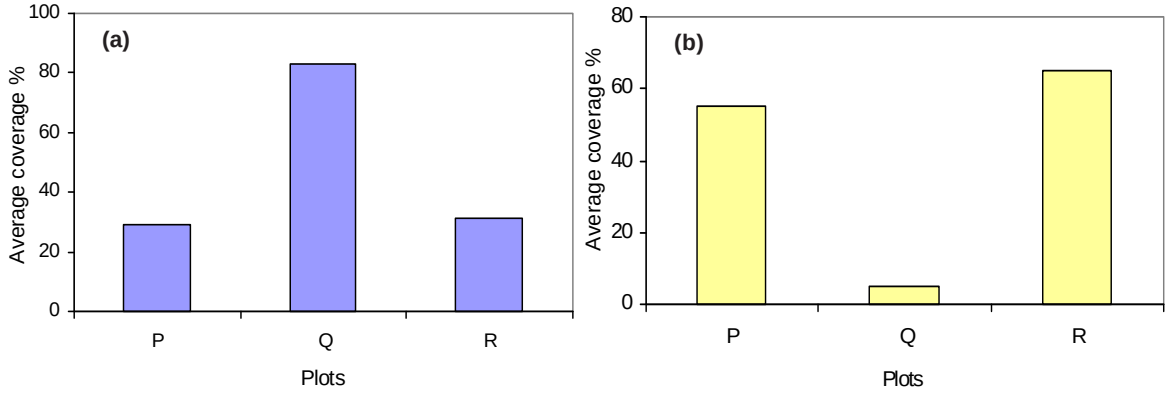

Figure 3. Coverage of weed (a), and wheat (b).

with their seeds having potent to germinate in next crop were allowed to grow as fodder of cattle. This practice is very helpful to enrich the seed bank in the soil, which paves way of vigorous weed emergence in the next batch of crop.

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Appendix 1. Species composition of wheat weeds.

SN	Latin name	Family	Local name
1.	*Arenaria* sp.	Caryophyllaceae	-
2.	*Avena fatua* L.	Graminae	Jangali Jau
3.	*Bidens* sp.	Compositae	Kuro
4.	*Blumea lacera* (Burm. f.) DC.	Compositae	-
5.	*Cannabis sativa* L.	Cannabaceae	Bhang
6.	*Centella asiatica* (L.) Urb.	Umbelliferae	Ghodtapre
7.	*Chenopodium album* L.	Chenopodiaceae	Bethe
8.	*Clerodendrum* sp.	Verbenaceae	-
9.	*Convolvulus* sp.	Convolvulaceae	Halinkhur
10.	*Conyza stricta* Willd.	Compositae	Salahajhar
11.	*Cynodon dactylon* (L.) Pers.	Graminae	Dubo
12.	*Cynoglossum* sp.	Boraginaceae	-
13.	*Cyperus difformis* L.	Cyperaceae	Mothe
14.	*Dichrocephala benthami* C.B. Clarke	Compositae	Chhuikejhar
15.	*Eclipta prostrata* L.	Compositae	-
16.	*Emilia sonchifolia* (L.) DC.	Compositae	mulapate
17.	*Gnaphalium affine* D.Don.	Compositae	Bokejhar
18.	*Indigofera linifolia* (L. f.) Retz.	Leguminosae	Kanikeghans
19.	*Ipomoea purpurea* (L.) Roth	Convolvulaceae	-
20.	*Juncus concinnus* D. Don.	Juncaceae	-
21.	*Kyllinga brevifolia* Rottb.	Cyperaceae	Mothe
22.	*Lathyrus sativus* L.	Leguminosae	-
23.	*Mazus surculosus* D. Don	Scrophulariaceae	Ramnejhar
24.	*Persicaria* sp.	Polygonaceae	Pirre
25.	*Plantago erosa* Wall.	Plantaginaceae	Isapgol
26.	*Poa annua* L.	Graminae	Antali
27.	*Polygonum hydropiper* L.	Polygonaceae	-
28.	*Polygonum plebeium* R. Br.	Polygonaceae	Pirejhar
29.	*Ranunculus sceleratus* L.	Ranunculaceae	Nakure
30.	*Sacciolepis indica* (L.) Chase	Graminae	Kaune banso
31.	*Sida rhombifolia* L.	Malvaceae	Barena
32.	*Spergula arvensis* L.	Caryophyllaceae	-
33.	*Sporobolus indicus* (L.) R. Br.	Graminae	-
34.	*Stellaria media* (L) Vill.	Caryophyllaceae	Armalejhar
35.	*Torenia* sp.	Scrophulariaceae	Lehu
36.	*Tridax procumbens* L.	Compositae	-
37.	*Trifolium repens* L.	Leguminosae	-
38.	Unidentified	-	-
39.	Unidentified	-	-
40.	Unidentified	-	-
41.	Unidentified	Boraginaceae	Kanikekuro
42.	*Vernonia cinerea* (L.) Less.	Compositae	Shahadeva
43.	*Vernonia* sp.	Compositae	-
44.	*Viola pilosa* Blume.	Violaceae	Ghatteghans