

The Effect of Weeds on Cropping System for Sustaining Food Security

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Abstract

Relay cropping of maize with finger millet (maize/finger millet) is the predominant cropping system for sustaining food security situation in the hilly regions of Nepal. In this region weed coverage severely reduced crop yields. There is any Basic information on weed species composition, biomass production and their effect on crop yields and economics. It is necessary to use this information to develop effective weed management strategies for the future. In light of this, an empirical study was carried out in two representatives mid-hill districts of Parbat and Baglung during the summer season of 2010/2011 in Nepal. Ten major weed species in Baglung with densities of 172 in Parbat and 311 per 0.25m² area were observed. The highest percentage of both relative and absolute densities were recorded for *Ageratum conyzoides* in Parbat and *Polygonum Chinensis* in Baglung. Weed invasion under farmer's practice of crop management reduced the maize grain yield by 1.985 Mt ha⁻¹ (117%) in Baglung and 1.760 Mt ha⁻¹ (108%) in Parbat. Similarly, in finger millet, it was 0.489 Mt ha⁻¹ (63%) in Baglung and 0.403 Mt ha⁻¹ in Parbat. In addition, the combined yield of both crops was also significantly reduced by 79.3% and 61.7% in Baglung and Parbat, respectively. Hence, weeds are directly affected the crop performance in this region. as results it could be recommended that, there is an urgent need to develop an alternative crop production system in the hills.

Keywords: Maize/Finger-Millet; Hills; Weeds; Index; Grain Yield

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1. Introduction

Maize (*Zea mays* L.) is the second and finger millet (*Eleusine coracana* Gaertn.) is the fourth cereal crops which are most widely produced in Nepal, and produced in the mid-hill regions over 70% of maize and 75% of finger millet. Of the total area under finger millet cultivation, 85% is relayed with maize in Nepal. Maize-millet systems are beneficial to farmers because of reduced land preparation and more efficient utilization of moisture, nutrient, and labor resources [1]. Yet low productivity of maize-millet systems (average yields of 2.5 Mtha⁻¹ for maize and 1.13 Mtha⁻¹ for finger-millet is hindering food security in the mid-hills [2]. Weed infestation is one of the major factors which contribute to low system productivity in the hills. However, there is

lack of information on the major weed species and their effects on yield for maize-millet systems. Therefore, the present investigation was carried out to identify the major weed species and determining what extent the weed infestation affect this system's yield in the mid-hills of Nepal.

2. Materials and Methods

2.1 Study site

This study was carried out at Pang village in Parbat and Langgaun in Baglung district in the western hill region of Nepal. The prevailing cropping system of the region was maize/finger millet during the rainy season and wheat/ rapeseed-mustard in winter. Soils of both locations were reddish-brown in color, clay-loam in texture and had a pH of 6.0 to 6.5 in Lunggaun and 6.0 in Pang. Total soil NPK was

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0.18%, 71ppm and 111mg kg⁻¹ in Lunggaun, and 0.21%, 65 ppm and 95 mg kg⁻¹ in Pang. Soil organic carbon at both locations was 1.6 percentage. The highest rainfall was recorded during July and June (1677 and 1558 mm, respectively). November and January received no rainfall. Averagely the maximum and minimum temperatures of the region were 22.39 and 12.11°C during the survey year.

2.2 Experimental setup

Maize seed was planted in both sites during the second week of April 2010. Finger millet was relay planted in standing maize 55 days after maize seeding. The crop was manured with ten tons of farmyard manure (fresh weight) per hectare during land preparation and 40 kilograms of urea (46% N) per hectare was applied as top dressing during the knee-high stage of the crop. All crops maintained under rainfed conditions.

Two weed management treatments representing conventional farmers' practice (FP) of weed management and weed free (WF) were implemented in the field of ten farmers, 5 from each village. Farmers performed all other field operations according to their usual practice. The comparison between FP vs. WF was carried out on five farmer's fields in both Pang and Lunggaun. Every field contained four plots included FPP and RPP treatments running parallel in strips. Quadrats were in 5m x 5m (25 m²). In the FP plots, farmers

performed three cultivations, the first at 30-40 days after seeding, the second at earthing up operation (inter-row cultivation) and the third at finger millet transplanting time. Cultivation operations were performed using a small locally iron made hoe. Thus Weed-free plots were also treated with three cultivations procedure as mentioned above, but, weeds were pulled out immediately after the emergence by hand on a regular interval by seven days basis.

2.3 Observations recorded

In order to record the dominant, weed species and work-out their relative density, absolute density, relative frequency, and absolute frequency under maize-based systems, 4 quadrants of 0.5 X 0.5 m² were placed in each farmer's field for all five plot. Weed species, densities, and biomass (dry weight) data were estimated from quadrats during the inter-row cultivation (earthing-up operation) at 75 days after seeding (DAS) of maize. The second observation was at crop physiological maturity stage. Weeds inside the quadrats were counted and classified and their biomass was recorded in grams per unit area. For this, the weeds inside each quadrat were harvested, recorded and then oven dried for 48 hours at 70°C. Average weed dry weight was calculated and then converted into m⁻². Various weed indexes were calculated as below:

$$\text{Relative population density (RD)(\%)} = \frac{\text{Absolute density for a given species}}{\text{Total absolute density for all species}} \times 100 \quad (1)$$

$$\text{Absolute population density} = \frac{\text{Total no. of individuals of a species in all quadrates}}{\text{Total number of quadrates}} \quad (2)$$

$$\text{Relative frequency (RF)(\%)} = \frac{\text{Absolute frequency value for a species}}{\text{Total absolute frequency values for all species}} \times 100 \quad (3)$$

$$\text{Absolute frequency (\%)} = \frac{\text{Number of quadrates in which species occur}}{\text{Total number of quadrates}} \times 100 \quad (4)$$

Table 1. Weeds and population in a 0.25 m² area during the rainy season under maize-based cropping system in Pang, Parbat

Quadrat No	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	Total
1	19	12	1	9	2	8	2	4	2	4	63
2	4	11	3	11	0	11	1	7	2	5	55
3	3	7	2	7	2	13	0	3	9	1	47
4	4	17	0	4	1	2	2	11	4	14	59
5	16	13	0	3	7	20	0	12	7	9	87
Species total	43	24	17	15	2	7	54	0	10	0	172

Note: The name of weed species are mentioned in table 3

Table 2. Weeds and population in a 0.25 m² area during rainy season under maize based cropping system in Lunggune, Baglung

Quadrat No	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	Total
1	19	12	1	9	2	8	2	4	2	4	63
2	4	11	3	11	0	11	1	7	2	5	55
3	3	7	2	7	2	13	0	3	9	1	47
4	4	17	0	4	1	2	2	11	4	14	59
5	16	13	0	3	7	20	0	12	7	9	87
Species total	46	60	6	34	12	54	5	37	24	33	311

Note: The name of weed species are mentioned in table 3

Table 3. Major weed species under maize-based cropping system

Weed species No	Nepali name	Scientific name
W1	Abhijalo	<i>Drymaria cordata</i>
W2	Ratnaulo	<i>Polygonum chinensis</i>
W3	Kodejhar	<i>Dactyloctenium aegypticum</i>
W4	Banso	<i>Echinochloa colonum</i>
W5	Mothe	<i>Cyperus rotundus</i>
W6	Kanejhar	<i>Commelina spp</i>
W7	Gandhe	<i>Ageratum conyzoides</i>
W8	Chariamilo	<i>Oxalis spp</i>
W9	Dubo	<i>Cynodon dactylon</i>
W10	Siru	<i>Imperata cylindrica</i>

Analysis of variance for yield parameters of maize and finger millet was performed by GENSTATC discovery version. Treatments were compared by "F-test" and significant differences between treatments were compared with Least Significant Difference (LSD) at 5% level of probability.

3. Results and Discussion

3.1 Major weeds and densities

density variation among weed species was found to be significant in both Parbat and Baglung. Almost all weed species were common in both the sites except *Imperata cylindrica* and *Oxalis spp* were not observed in Baglung. Weed density of *Drymaria*

cordata and *Cynodon dactylon* did not vary by the sites. However, higher densities were recorded in *Polygonum chinensis*, *Echinochloa colonum*, *Commelina spp* in Parbat inspite of Baglung. Whereas, only one species *Ageratum conyzoides* was recorded to be the highest in density in Baglung compared with Parbat (Table 1, 2 and 3). Similar weed species were also observed and reported in Lumle (1600 m.asl) in Kaski [3].

3.2 Weed indexes

In Parbat : The highest Relative Density (RD%) or Community Abundance (CA%) was observed in *Ageratum conyzoides* (W7) with 31.40 followed by 15 in *Drymaria cordata* (W1) and 13.95 in *Polygonum Chinensis* (W2) and 9.88 in *Dactyloctenium aegypticum* (W3) (Table 4).

Similarly, the Absolute Density (AD) was also observed as 10.8, 8.6, 4.8 and 3.4 in *Ageratum conyzoides* (W7), *Drymaria cordata* (W1), 13.95 in *Polygonum chinensis* (W2) and 9.88 in *Dactyloctenium aegypticum* (W3) respectively (Table 4).

Absolute frequency (AF%) (14.71) was recorded in *Drymaria cordata* (W1), *Polygonum chinensis* (W2) and *Dactyloctenium aegypticum* (W3) with the lowest value of 0 in *Ageratum conyzoides* (W7), *Cynodon dactylon* (W9) and *Imperata cylindrica* (W10) (Table 4).

Table 4. Relative and absolute densities, relative and absolute frequencies of major weed species across the survey districts

Particular	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	Total
Pang. Parbat											
RD (%)	25	14.0	9.9	8.7	1.2	4.1	31.4	0	5.8	0	100
AD	8.6	4.8	3.4	3	0.4	1.8	10.8	0	2	0	34
AF (%)	14.71	14.7	14.7	5.8	11.8	14.7	0	8.8	0	0	100
Lunggaun, Baglung											
RD (%)	14.8	19.3	1.9	10.9	3.9	17.4	1.6	11.9	7.7	10.6	100
AD	9.2	12	1.2	6.8	2.4	10.8	1.0	7.4	4.8	6.6	62.2
AF (%)	11.1	11.1	6.7	11.1	8.9	11.1	6.7	11.1	11.1	11.1	100

Note: name of weed species are mentioned in table 3

4. Conclusion

overall 10 weed species were found in common in maize field for both districts during 2009. Among them, grasses were dominant. The highest value was recorded for *Ageratum conyzoides* in Parbat and *Polygonum chinensis* in Baglung for the both relative and absolute densities. The higher absolute frequency percentage was recorded in *Drymaria cordata*, *Polygonum chinensis* and *Dactyloctenium aegypticum* had the lowest value of 0 in *Ageratum conyzoides*, *Cynodon dactylon*, and *Imperata cylindrica* in Parbat. as in

Baglung, the absolute frequency was higher than in *Drymaria cordata*,

Polygonum chinensis, *Echinochloa colonum*, *Commelina spp*, *Oxalis spp*, *Cynodon dactylon* and *Imperata cylindrica* with the lower value which was recorded in *Ageratum conyzoides* and *Dactyloctenium aegypticum*. maize grain yield under weed-free conditions was 2.5Mt ha⁻¹ in Parbat and 2.7 Mt ha⁻¹ in Baglung, whereas in weed management by farmer's practice it was 1.6 Mt ha⁻¹ in Parbat and 1.7 Mt ha⁻¹ in Baglung. Similarly, the grain yield of finger millet losses due to weed infestation was up to 47.2%, when the maize field

kept un-weeded throughout the first growing season.

Table 5. Grain yield of maize and finger millet as affected by weed management practices in Baglung and Parbat, 2010.

Location/practice	Grain yield (Mt ha ⁻¹)		
	Maize	Finger millet	Combined
Baglung			
Farmers practice	1.683	0.776	2.601
Weed free	3.668	1.265	4.666
Yield gain (Mt ha ⁻¹)	1.985 (117)	0.489 (63)	2.064 (79.3)
Parbat			
Farmers practice	1.628	0.829	2.751
Weed free	3.388	1.231	4.450
Yield gain (Mt ha ⁻¹)	1.760 (108.1)	0.403 (48.6)	1.699 (61.7)
Grand mean	2.595	1.025	3.617
LSD _{0.05}	0.225	0.106	0.312
CV,%	8.6	10.2	8.5
Note: Figures in the parentheses are the percentage increase in yield			

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