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THE NUTRIENT LOSSES THROUGH WEEDS OF WHEAT UNDER DIFFERENT MOISTURE LEVELS

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Abstract

Nutrient losses through winter weeds were determined in different rainfall zones of Punjab (Pakistan). On the basis of annual rainfall, Punjab Barani Tract was divided into four zones. In each zone weeds with manageable biomass were collected (14-16 Weeks After Sowing). These were analyzed for NPK uptake alongwith wheat which was the major crop of the area. The data revealed that in zone I (annual rainfall 150-300 mm), NPK uptake by Asphodellus tenuifolius and Convolvulus arvensis was higher than other weeds. In zone II (300-500 mm, annual rainfall) Convolvulus arvensis showed highest NPK uptake. In zone III (annual rainfall 500-1000 mm), Fumaria indica and Medicago polymorpha took away high NPK as compared to other weeds whereas in zone IV (annual rainfall 1000-1500 mm) Veronica didyma and Lamium amplexicaule showed high NPK than other weeds.

The highest nutrient losses were found in zone III where out of the total nutrient uptake weeds were responsible for 37% of nitrogen, 41% of phosphorus, and 32% of potassium.

Introduction

Most of the weeds are more competitive than crop plants (Fitter and Hay, 1981; Larcher, 1973 and Merrill and Lembi, 1985). According to a study made by Holm (1971), weeds contained approximately twice the nitrogen, 1.6 times phosphorus, 3.5 times potassium, 7.6 times calcium and 3.3 times magnesium as compared with that of corn. Mc Whorter and Hartwing (1972) studied that weeds could cause reduction in yield because of their competition for soil moisture, nutrients and light. In a field experiment, Khalid (1988) found that *Carthamus oxyacantha, Euphorbia helioscopia* and *Fumaria indica*, when allowed to grow with wheat under rainfed conditions, contained high percentage of nitrogen than the crop plants. There are many other reports which reinforce the intensive losses caused by weeds in terms of yield because of competition for soil nutrients and moisture (Yadav *et al.*,

1985, Bir and Sidhu, 1979, Williams and Hayes, 1981 and many others). This is perhap one of the reason that during the past fifty years extensive research programmes have bee carried out in different countries and the Weed Abstract listed more than three thousan research papers for just one year of 1973 (Klingman and Floyd, 1975).

In view of the above facts, the present study was conducted to estimate the nutrient losse through weeds in the rainfed area of Punjab. It may be specified here that the area ha already been declared as low in nutrients (Report of the Punjab Barani Commission, 1976)

Materials and Methods

The northern area of Punjab where wheat (*Triticum aestivum* L.) is grown under rainfe conditions during October to April was selected for this study. On the basis of the annua rainfall (with different climatic conditions) four zones were selected (Annexure A). Th details of the rainfall zones are given in Table 1.

Table 1. Categorization of Zones on the basis of annual 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

In every zone three sites were selected each differing from other on the basis of so texture to determine the role of physio-chemical characteristics of soil in weed establishmen However, this could not be achieved in zone IV as there was no sandy soil available and th soil texture was more or less the same. Following were the areas included in each site:

ZONE I

Site 1 — District Bhakkar, Tehsil Kalorekote, village Baranga, about 94 K short of Bhakkar while going from Mianwali.

Site 2 — District Bhakkar, Tehsil Kalorekote, village Chah Patwari Wal about 94 Km short of Bhakkar while going from Mianwali (abo 3 Km away from main road).

Site 3 — District & Tehsil Mianwali, near Rikhi More.

ZONE II

Site 1 — District Chakwal, Tehsil Talagang, Village Sagghar (near main road).

Site 2 — District Attock, Tehsil Fatehjang, Village Jibba Kasran (while going towards Attock 21 Km. away from Fatehjang.

Site 3 — District Attock, Tehsil Fatehjang, village Garhi Hassu Khan (5 Km away from Fatehjang).

ZONE III

Site 1 — District and Tehsil Islamabad, Village Dhoke Paracha (2 Km away from Turnol towards Peshawar).

Site 2 — District and Tehsil Islamabad, Village Rawat (near G. T. road, next to Rawat Fort).

Site 3 — District and Tehsil Islamabad, Village Nikki Harno about 20 Km from National Agricultural Research Centre (NARC) on Lehtrar road.

ZONE IV

Site 1 — District Rawalpindi, Tehsil Murree, near Tret (about 1 Km inside from main road).

Site 2 — District Rawalpindi, Tehsil Murree, Village Samli Tajal (near main road).

Site 3 — District Rawalpindi, Tehsil Murree, Village Hattian (opposite Mustafa Poultry Breeders, about 3 Km before Company Bagh).

At each site three adjacent fields with the same field history were selected. As such nine fields in each zone were investigated. Each field was approximately 25/30 m by 60/70 m with much wider fields in zone I & II and slightly less wide in zone IV.

Plant Analysis:

Observations were made 14-16 Weeks After Sowing (WAS), with the help of a quadrate measuring 50 cm each side. The quadrate was thrown randomly twenty four times according to random systematic sampling method described by Cochran (1977). Weeds, with their roots growing inside the quadrate were carefully pulled out from alternate quadrate, i.e. twelve quadrates in total. The collected plant samples were kept in labelled bags, placed at cool place and were brought to laboratory. Soil particles adhering to the roots were carefully

removed by washing with the help of a brush. The extra moisture was removed with the help of blotting paper. The samples were carefully parked in labelled paper bags separately for each species, and were dried in the oven at 70°C for 48 hours and were weighed for biomass/m^2. Those with negligible biomass were not analyzed further.

Nutrient Uptake

The dried plant samples (weeds/wheat) were grounded with Willey mill to reduce the samples to manageable size and to facilitate the preparation of homogenous sub-samples for chemical analysis. The prepared samples were stored shortly in paper bags till analysis. The plant material was analyzed for nitrogen, phosphorous and potassium. Calculations were made for N, P, K content (%) and uptake of nutrients in mg/m^2.

Following procedures were adopted for the analysis.

(i) Nitrogen (N): The plants were analysed for total nitrogen using Kjeldhal method as described by Winkleman *et al.*, (1990).

(ii) Phosphorus (P): The plant samples were digested with Nitric acid and Per Chloric acid mixture (2:1), as described by Winkleman *et al.*, (1990). The yellow colour was developed (Cottenie, 1980). The absorbance was recorded on spectronic 501 at 430 nm.

(iii) Potassium (K): The digested extract used for plant phosphorous estimation was also analysed for potassium. Potassium concentration in the digests was determined by flame photometer using Beckman Klina flame photometer (Cottenie, 1980).

The figures thus obtained were calculated as % of element in the plant material. Total uptake (mg/m^2) was calculated with the help of biomass per m^2.

Results and Discussion

As shown in Table 2, seven weeds and wheat plants have been analyzed for nutrient uptake in zone I where the annual rainfall is usually 150-300 mm. In this zone *Asphodellus tenuifolius* and *Convolvulus arvensis* were found to take away comparatively more nutrients than other weeds. On the whole seven weeds collected in this zone took away approximately 36% of nitrogen, 27% of phosphorus and 23% of potassium consumed by total vegetation of the area.

In zone II (Table 3), with 300 - 500 mm annual rainfall, *Convolvulus arvensis* deprived the soil by all the three nutrients much more than other weeds of this zone. Out of the total nutrient uptake seven weeds of this zone took away approximately 30% of nitrogen, 32% of phosphorus and 24% of potassium.

Table 2. Nutrient uptake by different weeds and wheat of rainfed wheat fields in zone I-annual rainfall 150-300 mm (Punjab, Pakistan)

Weeds	N(mg/m^2)	P(mg/m^2)	K(mg/m^2)
Asphodelus tenuifolius	91.6	31.5	84.2
Convolvulus arvensis	75.2	23.7	62.0
Euphorbia dracunculoides	9.2	2.5	7.4
Fumaria indica	3.3	0.9	2.2
Malcolmia cabulica	5.1	1.5	3.4
Tribulus terrestris	2.0	0.6	2.1
Trigonella monantha	1.4	0.4	1.4
Total	187.8	61.1	162.7
Wheat	333.8	165.3	538.2

Note: Each figure is an average of three years' data.

Table 3. Nutrient uptake by different weeds and wheat of rainfed wheat fields in zone II-annual rainfall 300-500 mm (Punjab, Pakistan)

Weeds	N(mg/m^2)	P(mg/m^2)	K(mg/m^2)
Anagallis arvensis	4.1	2.7	4.2
Asphodelus tenuifolius	35.8	12.2	24.0
Carthamus oxyacantha	37.5	11.2	20.4
Convolvulus arvensis	100.9	42.7	48.0
Fumaria indica	32.8	11.6	20.9
Trigonella monantha	38.0	12.9	23.6
Vicia sativa	14.8	5.5	7.5
Total	263.9	98.8	148.6
Wheat	622.9	213.8	470.3

Note: Each figure is an average of three years' data.

In case of zone III (Table 4), the percentages are even higher and the ten important weed of this area deprived the soil by 37% nitrogen, 41% phosphorus and 32% of total potassiu utilized by the crop and weeds both. In this zone *Fumaria indica* and *Medicago polymorph* appear to be important weeds of the area as their nutrient uptake is much higher than oth weeds (Table 4).

Table 4. Nutrient uptake by different weeds and wheat of rainfed wheat fields in zone III-annual rainfall 500-1000 mm (Punjab, Pakistan)

Weeds	N(mg/m^2)	P(mg/m^2)	K(mg/m^2)
Avena fatua	47.3	16.0	27.2
Buglossoides arvensis	63.1	35.8	61.4
Chenopodium album	22.5	9.3	31.8
Convolvulus arvensis	9.2	3.1	5.1
Fumaria indica	306.8	154.8	185.8
Lathyrus aphaca	15.8	6.4	9.4
Medicago polymorpha	192.7	69.6	111.2
Melilotus indicus	28.8	33.3	33.4
Phalaris minor	16.0	11.0	12.5
Ranunculus muricatus	46.7	14.3	34.5
Silene conoidea	51.6	31.9	71.1
Torilis leptophylla	16.6	4.5	10.4
Veronica didyma	21.0	11.2	24.2
Vicia sativa	53.6	17.9	30.1
Total	891.7	419.1	648.1
Wheat	1510.0	603.3	1362.9

Note: Each figure is an average of three years' data.

Table 5 shows the data of zone IV where the annual rainfall is 1000-1500 mm. In this zo ten dominant weeds were analyzed for this purpose. Out of these *Veronica didyma* a *Lamium amplexicaule* appear to be more important in terms of nutrient uptake as they to away comparatively higher amount of nutrients as compared to other weeds. Out of the to

nutrient uptake weeds are responsible for approximately 29% of nitrogen, 30% of phosphorus and 29.5% of potassium.

Table 5. Nutrient uptake by different weeds and wheat of rainfed wheat fields in zone IV-annual rainfall 1000-1500 mm (Punjab, Pakistan)

Weeds	N(mg/m^2)	P(mg/m^2)	K(mg/m^2)
Avena fatua	38.6	34.6	37.7
Buglossoides arvensis	12.7	11.3	13.5
Galium aparine	25.4	21.5	24.7
Lamium amplexicaule	128.2	65.5	130.5
Lepedium sativum	11.7	14.8	10.9
Medicago polymorpha	72.2	51.0	58.1
Ranunculus muricatus	26.8	17.6	24.6
Stellaria media	38.2	37.8	59.5
Veronica didyma	183.8	135.9	189.7
Vicia sativa	16.8	7.3	10.1
Total	554.4	397.3	559.3
Wheat	1327.7	946.8	1338.3

Note: Each figure is an average of three years' data.

A comparative study of Tables 2, 3, 4 and 5 reveals that nutrient uptake by weeds remained the highest in zone III where the annual rainfall is 500 - 1000 mm. This appears to be because of the fact that the area is infested by high density of weeds as compared to other rainfall zones (Naeem, 1993). Similar results of high nitrogen uptake by weeds have been reported by Khalid (1988). In her study, she also found that the high uptake of nitrogen by *Phalaris minor* is not because of its high nitrogen content but the high biomass. At the same time, weeds like *Chenopodium murale, Lathyrus aphaca* and *Fumaria parviflora* were found to have high N, P, K contents when analyzed in a rainfed area (Sher *et al.*, unpublished).

To conclude, the weeds of Barani Tract of Punjab take away high percentage of nutrients and thus deprive the soil which is already quite low in fertility. Moreover, due to difference in annual rainfall, the weed problem also varies from area to area and the Tract cannot be treated as one unit for any weed management programme.

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