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Monthly nutrient uptake by weeds in different land use systems at two locations of Punjab, India

Jashanpreet Kaur*, Rajni Sharma, Sandeep Sharma[1] and Jiwan

Department of Botany, Punjab Agricultural University, Ludhiana, Punjab 141 001, India

[1]Department of Soil Science, Punjab Agricultural University, Ludhiana, Punjab 141 001, India

**Email: jashan2705@gmail.com*

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ABSTRACT

In present study, biomass production and nutrient status (NPK) of weeds in three land use systems (canal bunds, fallow land and in cultivated land) at two locations (Ludhiana and Sangrur) of Punjab was analyzed throughout year (Jan-Dec 2017) at monthly interval. In case of land use systems fallow land (Sangrur) was recorded to have maximum total biomass (5.73 t/ha), nitrogen (96.9 kg/ha), phosphorus (21.5 kg/ha) and potassium (85.9 kg/ha). With respect to months, total maximum weed biomass production (7.40 t/ha), nitrogen (147.8 kg/ha), phosphorus (27.8 kg/ha) and potassium (125.8 kg/ha) was recorded in July. Thus from present data it is revealed that weeds which grow lavishly in fallow lands of Punjab possess high nutrient value and dry matter production of weeds in this land use system increased with heavy rainfall.

INTRODUCTION

Weeds are unwanted plants that grow out of place. These can be seen growing lavishly in fallow lands, rock cervices, city wastelands, roadsides, railway cracks and orchards. Weeds have evolved mechanisms to cope with stresses and exploit opportunities of disturbances (Mohler 2001). Increasing pressure to enhance output from limited land has increased use of herbicides, synthetic fertilizers and insecticides. These in turn have adversely affected quality of soil and underground water. So to overcome these problems of weeds interest of people in organic farming is increasing day by day. Organic farming is a production system which avoids use of herbicides, fertilizers and pesticides and relies merely on recycling of nutrients produced on the farm. Farmyard manure (FYM) and compost are main sources of manuring in organic farming and these are becoming scare and costly due to reduction in cattle population and increase in mechanization. Weed species could be used in enriching the compost as nutrient content of weeds is generally high. The present study was an attempt to estimate nutrient content in weed species and to identify the weed species which could possibly be used in-situ or mixed with compost as a resource of nutrients.

Parthenium hysterophorus, Cassia serecia, Chromolaena sp. and *Portulaca oleracea* which grow in abundance in wastelands were effectively used in cultivation of hybrid sorghum by Channappagovdar *et al* (2007). Hybrid maize was cultivated with composts of these four weeds prepared at two stages (before and after flowering) along with organic manures *i.e.* farmyard manure, poultry and cow dung waste. Nitrogen content was highest in compost of *P.hysterophorus* (2.95%) followed by *Chromolena* sp (2.32) at pre-flowering stage. Poultry compost had highest phosphorus (1.6%) and potassium (1.42%) whereas *P.hysterophorus* contained 0.82% phosphorus and 1.3% potassium.

MATERIALS AND METHODS

Study site

The present study was carriedin2017 (January - December) in three land use systems *i.e.* fallow land, canal bunds and cultivated land of two locations in Punjab, *viz.* Ludhiana (30.54° N and 75.48° E) and Sangrur (30.25° N and 75.84° E) districts. The climate of both sites was subtropical humid with very hot summers and cold winters.

Monthly meteorological data of Ludhiana and Sangrur for period January - December 2017, are given in figure 1 and figure 2, respectively.

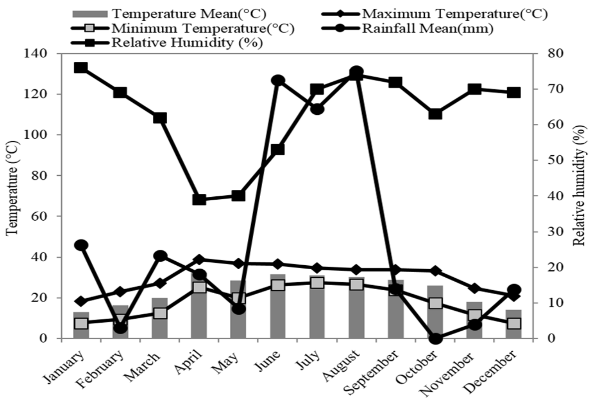

Figure 1. Monthly meteorological data of Ludhiana for period January - December 2017

Source: School of Climate Change and Agrometerology, PAU, Ludhiana

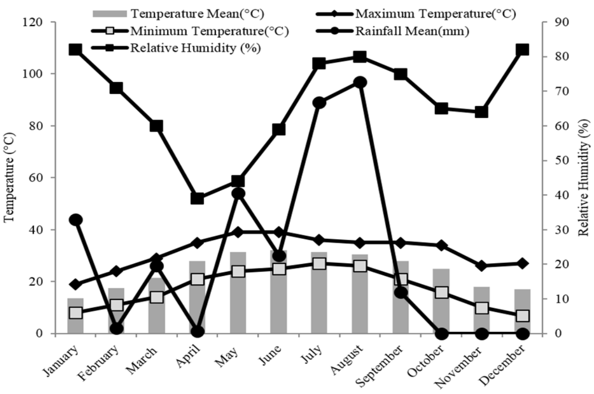

Figure 2. Monthly meteorological data of Sangrur for the period January - December 2017

Source: Krishi Vigyan Kendra, Kheri, Sangrur

Methods

In each land use system of both locations two fixed quadrats (1.0 x 1.0 m) were laid down in three replications. The plants were uprooted along with roots from these quadrats at an interval of 30 days and weed species names were recorded. The uprooted weeds were dried first in the field and then in oven. The dried samples were together ground and then analyzed for macro nutrients *i.e.* Nitrogen, phosphorus and potassium.

Estimation of nutrients

Nitrogen, phosphorus and potassium were estimated by following standard procedures.

a. Nitrogen: Wesertmann (1990)

b. Phosphorus: Vanado molybdo phosphoric acid method by Jackson 1987

c. Potassium: Flame photometric method by Chapman and Pratta 1961

$$\text{Nutrientuptake (kg/ha)} = \frac{\text{Nutrient concentration (\%) Î dry matter (kg/ha)}}{100}$$

Statistical analysis

To test the significance of treatments analysis of variance (ANOVA) followed by least significant difference (LSD) test at p= 0.05 level was carried out.Experiment data was analyzed as per standard statistical procedure for factorial randomized block design as prescribed by Cochran and Cox (1967) and adapted by Cheema and Singh (1991) in statistical package CPCS1, software developed by Department of Mathematics and Statistics, PAU, Ludhiana.

RESULTS AND DISCUSSION

The weed species uprooted from quadrats of each location showed variation with respect to locations and land use systems. All the weed species recorded from studied sites were alphabetically arranged and presented in **Table 1**.

Weed biomass production was found to vary significantly during different months as well as locations and land use systems (**Table 2**). Maximum biomass production was recorded in fallow land at both locations in month of July with values of 1.33 t/ha (Ludhiana) and 3.74 t/ha (Sangrur) followed by biomass production in September. Similarly, canal bunds of Sangrur showed maximum production in July (1.22 t/ha) however in Ludhiana canal bunds it was reported in September (0.65 t/ha). The cultivated land of both locations showed maximum biomass production in September *i.e.* 412.0 kg/ha (Sangrur) and 368.3 kg/ha (Ludhiana).

It was concluded that both in Ludhiana and Sangrur maximum mean rainfall was during June-September which effects the growth of weeds positively in all land use systems (**Figure 1**). Moreover, during the cold season *i.e.* in January minimum weed biomass was recorded in almost all land use systems.

Nitrogen

Differences in nitrogen uptake (**Table 3**) were statistically significant for months, location and land uses systems and their interactions. Plant species in fallow lands of both locations *i.e.* Ludhiana and Sangrur showed increase in nitrogen uptake from January to July after which it declined at both land use systems and locations.

In case of canal bunds, maximum nitrogen uptake by weed species in Ludhiana was recorded in September (15.2 kg/ha) whereas in Sangrur it was recorded in July (23.5 kg/ha).

In Cultivated land of both locations, maximum nitrogen uptake by plant species was recorded in March with values 5.4 kg/ha in Sangrur and 7.6 kg/ha in Ludhiana.

Table 1. Plant species recorded in different land use systems

Land use systems Months	Fallow land (Ludhiana)	Fallow land (Sangrur)	Canal bunds (Ludhiana)	Canal bunds (Sangrur)	Cultivated land (Ludhiana)	Cultivated land (Sangrur)
January	*Cassia occidentalis*	*Achyranthes aspera*	*Cannabis sativa*	*Abutilon indicum*	*Anagalis arvensis*	*Anagalis arvensis*
	Chenopodium album	*Cannabis sativa*	*Cassia occidentalis*	*Cannabis sativa*	*Sisymbrium irio*	*Cynodon dactylon*
	Malva parviflora	*Cassia occidentalis*	*Chenopodium album*	*Urena lobata*	*Spergula arvensis*	*Stellaria media*
	Parthenium hysterophorus	*Dicliptera brachiata*	*Cenchrus biflorus*	-	*Stellaria media*	-
	Sisymbrium irio	*Urena lobata*	*Ricinus communis*	-	-	-
March	*Cassia occidentalis*	*Cannabis sativa*	*Cannabis sativa*	*Abutilon indicum*	*Gnaphalium purpureum*	*Foeniculum vulgare*
	Cannabis sativa	*Cassia occidentalis*	*Cassia occidentalis*	*Cannabissativa*	*Malvaparviflra*	*Cynodon dactylon*
	Parthenium hysterophorus	*Sisymbrium irio*	*Chenopodium album*	*Chenopodium album*	*Sisymbrium irio*	*Malva parviflora*
	Sida acuta	*Spergula arvensis*	*Malva parviflora*	*Urena lobata*	*Spergula arvensis*	-
	Sisymbrium irio	*Urena lobata*	-	-	-	-
May	*Cassia occidentalis*	*Achyranthes aspera*	*Achyranthes aspera*	*Cannabis sativa*	*Amaranthus viridis*	*Foeniculum vulgare*
	Cannabis sativa	*Cannabis sativa*	*Cannabis sativa*	*Chenopodium album*	*Bidens pilosa*	*Cynodon dactylon*
	Parthenium hysterophorus	*Cassia occidentalis*	*Cassia occidentalis*	*Abutilon indicum*	*Eragrostis tenella*	-
	Sida acuta	*Parthenium hysterophorus*	*Parthenium hysterophorus*	-	-	-
	Tephrose pupurea	*Urena lobata*	-	-	-	-
July	*Artemisia scoparia*	*Boerhaavia diffusa*	*Cannabis sativa*	*Boerhaavia diffusa*	*Eragrostis tenella*	*Digitaria sanguinalis*
	Cassia occidentalis	*Chenopodium album*	*Cassia occidentalis*	*Cannabis sativa*	*Bidens pilosa*	*Trianthema portulacastrum*
	Cannabis sativa	*Parthenium hysterophorus*	*Parthenium hysterophorus*	*Chenopodium album*	*Dactyloctenium aegyptium*	-
	Chenopodium album	*Sida acuta*	-	-	-	-
	Parthenium hysterophorus	*Tribulus terrestris*	-	-	-	-
September	*Artemisia scoparia*	*Cannabis sativa*	*Achyranthes aspera*	*Achyranthes aspera*	*Commelina benghalensis*	*Cannabis sativa*
	Cassia occidentalis	*Cassia occidentalis*	*Cassia occidentalis*	*Cannabis sativa*	*Digitaria sanguinalis*	*Rumex dentatus*
	Cannabis sativa	*Parthenium hysterophorus*	*Parthenium hysterophorus*	*Chenopodium album*	*Bidens pilosa*	-
	Chenopodium album	*Sida acuta*	-	-	-	-
	Parthenium hysterophorus	*Tribulus terrestris*	-	-	-	-
November	*Cassia occidentalis*	*Cannabis sativa*	*Chenopodium album*	*Chenopodium album*	*Amaranthus viridis*	*Chenopodium album*
	Cannabis sativa	*Cassia occidentalis*	*Sida acuta*	*Sida acuta*	*Cassia occidentalis*	*Rumex dentatus*
	Dicliptera brachiate	*Parthenium hysterophorus*	*Sisymbrium irio*	*Sisymbrium irio*	*Chenopodium album*	-
	Parthenium hysterophorus	*Sida acuta*	*Urena lobata*	*Urena lobata*	*Digitaria sanguinalis*	-
	Sida acuta	*Tephrosia purpurea*	-	-	-	-

Phosphorus

Phosphorus uptake (**Table 4**) for locations, months and land use systems and their interactions differed significantly.

The maximum uptake value for plants of fallow land of Ludhiana and fallow land of Sangrur was 3.8 kg/ha and 17.7 kg/ha respectively which was recorded in July.

Table 2. Monthly biomass production (kg/ha) in different land use systems of two locations

Land use / Locations / Months	Fallow land		Canal bunds		Cultivated land	
	Ludhiana	Sangrur	Ludhiana	Sangrur	Ludhiana	Sangrur
January	164.2	268.0	183.3	93.2	212.2	194.8
March	220.5	226.5	106.2	33.3	266.8	230.3
May	284.3	233.0	177.3	178.7	277.7	214.5
July	1331.3	3744.3	486.2	1219.3	360.7	256.5
September	484.5	650.2	650.0	970.7	412.0	368.3
November	264.7	606.3	274.2	334.5	232.0	184.8
Mean	458.3	954.7	312.9	471.6	293.6	241.5
Total	2748.8	5733.0	1885.3	3009.5	1763.1	1456.2

LSD (p= 0.05) LSD (month): 27.8, LSD (location):16.0, LSD (land use): 19.6
LSD (month*location): 39.3, LSD (month*land use): 48.1; LSD (landuse*location): 27.8, LSD (month*location*land use): 68.0

Table 3. Monthly nitrogen uptake (kg/ha) by weeds in different land use systems at two locations

Land use / Locations / Months	Fallow land		Canal bunds		Cultivated land	
	Ludhiana	Sangrur	Ludhiana	Sangrur	Ludhiana	Sangrur
January	4.0	3.1	4.6	1.1	6.7	4.4
March	5.9	2.5	2.7	0.6	7.7	5.4
May	6.1	5.7	4.8	2.5	4.6	2.8
July	29.6	66.1	8.4	23.5	7.6	4.5
September	11.5	8.3	15.2	17.4	5.7	5.2
November	4.5	11.2	5.2	11.1	2.5	5.3
Total	61.7	96.9	40.9	56.3	34.8	27.7
Mean	10.3	16.2	6.8	9.4	5.8	4.6

LSD (p= 0.05) LSD (month): 8.4, LSD (location): 4.9, LSD (land use): 5.9
LSD (month*location): 0.6, LSD (month*land use): 11.9, LSD (month*location*land use): 20.7

Table 4. Monthly phosphorus uptake (kg/ha) by weedsn in different land use system at two locations

Land use / Locations / Months	Fallow land		Canal bunds		Cultivated land	
	Ludhiana	Sangrur	Ludhiana	Sangrur	Ludhiana	Sangrur
January	0.5	0.3	0.4	0.2	0.7	0.46
March	0.6	0.7	0.3	0.1	1.2	0.65
May	1.2	0.4	0.3	0.4	0.3	0.35
July	3.9	17.7	1.1	3.7	0.5	0.92
September	0.8	1.5	1.1	1.5	1.4	0.80
November	1.1	0.9	0.9	1.0	0.7	0.36
Total	8.1	21.6	4.1	6.9	4.9	3.5
Mean	1.4	3.6	0.7	1.2	0.8	0.6

LSD (p= 0.05) LSD(month): 0.39, LSD (location): 0.5, LSD (land use): 0.62
LSD (month*location): 0.12, LSD (month*land use): 0.76, LSD (month*location*land use): 0.25

Canal bunds plants also showed maximum values in July which was 3.6 kg/ha and 1.1 kg/ha for Sangrur and Ludhiana respectively.

For cultivated land plants nutrient uptake, in Ludhiana maximum uptake recorded was 1.4 kg/ha in September however, in Sangrur maximum value recorded was 0.9 kg/ha in July.

Potassium

Differences inpotassium uptake (**Table 5**) were also highly significant for locations, months and land use systems and their interaction.

Maximum potassium uptake by plants in fallow land of both locations was recorded in July with values 32.6 kg/ha (Ludhiana) and 52.3 kg/ha (Sangrur).

In case of canal bunds, for Sangrur maximum uptake of 24.9 kg/ha by weed species was recorded in July whereas in Ludhiana maximum uptake *i.e.* 11.9 kg/ha was recorded in September.

For cultivated land Sangrur maximum potassium uptake *i.e.* 6.3 kg/ha by plants was recorded for January whereas in Ludhiana maximum production *i.e.* 6.1 kg/ha was recorded in September.

Table 5. Monthly potassium uptake (kg/ha) by weeds in different land use system at two locations

Land use	Fallow land		Canal bunds		Cultivated land	
Months / Locations	Ludhiana	Sangrur	Ludhiana	Sangrur	Ludhiana	Sangrur
January	6.7	4.6	4.7	1.43	4.7	6.3
March	5.5	5.8	2.3	0.6	5.1	4.9
May	10.2	7.8	4.6	3.1	3.1	2.7
July	32.6	52.3	10.7	24.3	3.5	2.7
September	7.7	6.6	11.9	11.4	6.1	6.2
November	4.8	9.1	3.8	8.6	3.9	2.4
Total	67.6	85.8	37.9	49.2	26.4	25.1
Mean	11.3	14.4	6.3	8.2	4.4	4.2

LSD (p= 0.05) LSD (month): 0.1, LSD (location): 0.7, LSD (land use): 0.9
LSD (month*location): 0.2, LSD (month*land use): 2.0, LSD (month*location*land use): 2.9

In present study, the biomass production and nutrients uptake (NPK) was recorded to be maximum in July / September and among land use systems maximum content was recorded for fallow land (Sangrur). Nutrient uptake is a function of dry weight and so nutrient uptake increased with increase in dry biomass. The rainfall recorded was also maximum in July which favored growth of highly dense weeds population and eventually increased the biomass production in turn nutrient uptake also increased. Besides environmental conditions, it was also recorded that in these months majority of plants were in flowering stage. Thus, at flowering stage nutrient uptake by plants is generally high.

Similarly dry weight and NPK content in herbaceous weeds in fields of *Nigella sativa* grown in arid areas of Iran for two years (2011 to 2012) was recorded by Seyyedi *et al.* (2016). It was concluded that dry weight and NPK of *N. sativa* weeds increased with increase in weed infestation. In this study it was also reported that with increase in weed infestation NPK content is 1.8-2 times higher in weeds compared to *N. sativa* crop.

Mahanta *et al.* (2009) recorded NPK content of many important terrestrial weeds, *viz. Achyranthes aspera*: 1.90, 0.75 and 2.50%, in *Amaranthus viridis*: 3.16, 0.06 and 4.51%, in *Chenopodium album*: 2.59, 0.37 and 4.34%, in *Cynodon dactylon* 1.72, 0.24 and 1.75% and in *Cyperus rotundus*: 2.17, 0.26 and 2.73%. It was concluded in this study that due to such a high per cent of nutrient composition, these herbaceous terrestrial weeds can be used in preparation of green manures, which are best alternative of chemical fertilizers.

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