



Fertility levels and weed management influence on weed dynamics, yield and nutrient uptake in lentil

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ABSTRACT

A field experiment was conducted during the winter seasons of 2012–13 and 2013–14 at Varanasi (U.P.) to evaluate the effect of fertility levels and weed management on lentil and associated weeds. *Cyperus rotundus*, *Chenopodium album*, *Solanum nigrum* and *Cynodon dactylon* were the major weeds found in association with lentil. Application of 75% RDF + Plantgro 9 kg/ha (foliar spray at 35, 50 and 65 DAS) recorded minimum density and dry matter accumulation of weeds and recorded higher yield attributes, yield (1.28 t/ha) and nutrient uptake by the crop followed by 100% RDF + 2% urea spray at pre-flowering and pod initiation. Among herbicides, application of imazethapyr 37.5 g/ha minimized the density and dry matter accumulation by weeds, and significantly increased yield attributes, yield and nutrient uptake by crop.

Key words: Fertility, Foliar, Imazethapyr, Lentil, Nutrient uptake, PlantGro, Weed management

Foliar application is regarded as a preferred solution when the quick supply of nutrients is hindered or the soil conditions are conducive for the absorption of nutrients (Salisbury and Ross 1995). Urea is the most suitable nitrogen source for foliar application due to its low salt index and high solubility in comparison to other nitrogen sources. Urea has been shown to stimulate absorption of other nutrients by increasing the permeability of leaf tissue. Plantgro Magic is a fertilizer product. The multi-nutrient water soluble fertilizer (57.1% total nutrients) includes nitrogen, phosphorus, and potassium as primary nutrients. It contains 18% total nitrogen of which 5.9% is ammonical nitrogen, 4.8% nitrate nitrogen and 7.3% urea nitrogen. This product also contains 30% available phosphate and 15% soluble potash. It also includes micronutrients such as boron (0.02%), copper (0.07%), iron (0.15%), manganese (0.10%), molybdenum (0.0005%), and zinc (0.15%).

Weeds compete with crop plants for nutrients, moisture, space and light. Crop yield reductions up to 70% have been reported due to weed competition. Impact of weeds on lentil varied as a function of climate, weed density and length of competition period (Dixit and Varshney 2009). The use of post-emergence herbicide for season-long weed control is preferred over early use of herbicides as pre-plant incorporation (fluchloralin and trifluralin) and pre-emergence (pendimethalin) as the latter control weeds only during initial crop growth stage (upto 30

DAS). The imidazolinone class of herbicides provides a broad-spectrum of weed control activity (Kantar *et al.* 1999). Therefore, the present study was undertaken to work out the effect of fertility levels and weed management on weed dynamics, yield and nutrient uptake by lentil crop.

MATERIALS AND METHODS

A field experiment was conducted for two consecutive years (2012 and 2013) during winter season at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (geographical location *i.e.* lat, long, altitude is required) (U.P.) The soil of the experimental field was clay loam in texture with neutral reaction (pH 7.31), low in organic carbon (0.37%), available N (212.50 kg/ha), medium in available phosphorus (25.17 kg/ha) and potassium (234.15 kg/ha). The experiment was laid out in a split plot design. Main plot treatments comprised of six fertility levels, *viz.* control, 100% RDF (20, 40, 30 kg N, P₂O₅ and K₂O/ha), 75% RDF + 2% urea spray at pre-flowering and pod initiation, 75% RDF + Plantgro 9 kg/ha at 35, 50 and 65 DAS as foliar spray, 100% RDF + 2% urea spray at pre-flowering at pod initiation, 100% RDF + Plantgro 9 kg/ha at 35, 50 and 65 DAS as foliar spray and four weed management practices, *viz.* control, weed free, pendimethalin 1.0 kg/ha (pre-emergence), imazethapyr 37.5 g/ha as post-emergence. All the treatments were replicated thrice. Fertilizers were applied as basal before sowing, to the different plots as per the treatment, through urea, single super phosphate and muriate of

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potash respectively. Sowing of the crop lentil variety ‘HUL-57’ was done on November 22 in both the years by maintaining a spacing of 25 x 5 cm. The data recorded on density and dry matter accumulations by weed were subjected to square root transformation $\sqrt{x+0.5}$ for uniformity.

Crop responses to different treatments were measured in terms of various quantitative and qualitative indices. All the herbicides were applied as per protocol of application time. The data on weed density and dry matter were recorded with the help of a quadrat (0.5 x 0.5 m) placed in each plot and then converted into per square metre (m²). Weed free and unweeded control treatments were kept for comparison with different treatments. Yield attributes viz. number of pods/plant, number of seeds/ pod, test weight and yield i.e. grain yield (t/ha) and straw yield (t/ha) were recorded at harvest during both the years of experimentation.

RESULTS AND DISCUSSION

Effect on weeds

The experimental field was infested with broad-leaved weeds viz. *Chenopodium* spp. RD (relative

density) varied from 11.08 to 27.44) and *Solanum nigrum* (RD 9.90 to 13.97); sedges *Cyperus* spp. (RD 43.24 to 49.65%) and *Cynodon dactylon* (RD 4.12 to 8.95%) to the grass group during the two years of field experimentation. Other weeds were in negligible presence and sparse in population, viz. *Parthenium hysterophorus*, *Fumaria parviflora*, *Anagallis arvensis*, *Vicia sativa*, *Melilotus indica* and *Medicago polymorpha*.

Data revealed that the density of grasses, sedges and broad-leaved weeds at 30 DAS was not affected significantly by varying fertility levels and weed management treatments except application of pendimethalin 1.0 kg/ha as pre-emergence (Table 1). Among fertility levels, application of 75% RDF + Plantgro 9 kg/ha recorded the minimum weed density of grasses, sedges and broad-leaved weeds and was at par with the application of 100% RDF + 2% urea spray. The highest weed control efficiency was recorded with the application of 75% RDF + Plantgro 9 kg/ha and was at par with 100% RDF + 2% urea spray. The results thus obtained corroborated with the findings of Mishra *et al.* (1999) and Prajapati *et al.* (2004).

Table 1. Weed density, weed dry matter accumulation, weed control efficiency and weed index as influenced by varying fertility levels and weed management treatments (pooled mean of two years)

Treatment	Weed density(no./m ²)				Dry matter accumulation (g/m ²)				WCE (%) ^a	Weed Index
	<i>Cynodon dactylon</i>	<i>Cyperus</i> spp.	<i>Chenopodium album</i>	<i>Solanum nigrum</i>	<i>Cynodon dactylon</i>	<i>Cyperus</i> spp.	<i>Chenopodium album</i>	<i>Solanum nigrum</i>		
<i>Fertility levels</i>										
100 % RDF	1.91 (3.8)	5.53 (43.1)	3.39 (18.4)	2.40 (7.9)	1.45 (1.8)	2.69 (8.2)	2.34 (6.4)	1.57 (2.3)	52.8	11.1
75% RDF+ 2% urea spray at pre-flowering and pod initiation	1.97 (4.0)	5.67 (45.5)	3.51 (19.6)	2.52 (8.7)	1.47 (1.9)	2.86 (9.5)	2.44 (6.7)	1.60 (2.5)	50.9	14.6
75% RDF + Plantgro 9 kg/ha at 35, 50, 65 DAS as foliar spray	1.75 (3.0)	5.30 (39.7)	3.18 (16.6)	2.08 (5.5)	1.25 (1.2)	2.56 (7.4)	2.13 (5.3)	1.53 (2.1)	54.4	5.6
100% RDF + 2% urea spray at pre-flowering and pod initiation	1.86 (3.5)	5.39 (41.1)	3.27 (17.5)	2.32 (7.3)	1.31 (1.3)	2.67 (8.2)	2.25 (5.8)	1.54 (2.2)	53.5	8.1
100% RDF + Plantgro 9 kg/ha at 35, 50, 65 DAS as foliar spray	2.03 (4.3)	5.79 (47.3)	3.57 (20.1)	2.56 (9.2)	1.52 (2.2)	2.97 (10.3)	2.54 (7.5)	1.64 (2.7)	48.5	15.8
Control	2.21 (5.4)	5.89 (48.9)	3.75 (21.4)	2.70 (10.2)	1.70 (3.0)	3.11 (11.6)	2.69 (8.5)	1.86 (3.8)	47.8	16.9
LSD (p=0.05)	0.03	0.11	0.06	0.04	0.03	0.05	0.05	0.02	-	-
<i>Weed management</i>										
Pendimethalin 1.0 kg/ha as pre-emergece	2.47 (5.7)	8.91 (79.0)	3.37 (10.9)	1.60 (2.1)	1.58 (2.0)	3.64 (12.8)	2.84 (7.8)	1.52 (1.8)	41.4	15.0
Imazethapyr 37.5 g/ha as post-emergence	1.81 (2.8)	3.40 (11.1)	1.80 (2.8)	2.31 (4.9)	1.47 (1.7)	2.74 (7.1)	2.09 (3.9)	1.68 (2.3)	63.9	11.1
Unweeded	2.83 (7.6)	9.35 (87.1)	7.90 (62.0)	5.10 (25.7)	2.04 (3.9)	4.14 (16.9)	3.95 (15.1)	2.59 (6.3)	0.0	22.6
Weed free	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	0.71 (0.0)	100.0	0.0
LSD(p=0.05)	0.02	0.06	0.04	0.03	0.02	0.04	0.03	0.02	-	-

^aObservation recorded at 60 DAS, Data subjected to square root ($\sqrt{x+0.5}$) transformation and original data presented in parentheses

Weed control treatments brought about a significant reduction in weed density. Among the weed management treatments at 60 DAS, the lowest density of grasses, sedges, broad-leaved weeds was observed with the application of imazethapyr 37.5 g/ha. Further, higher weed control efficiency (63.88%) was recorded under the application of imazethapyr 37.5 g/ha. Superiority of imazethapyr in suppressing the weed density and recording higher weed control efficiency has been reported by Punia *et al.* (2011).

Effect on growth

The growth parameters of lentil, *viz.* plant height, branches/plant and dry matter accumulation were highest under the treatment 100% RDF + Plantgro 9 kg/ha and it was at par with the application of 100% RDF + 2% urea spray (Table 2). Lower values of all the growth attributes was recorded with control (no fertilizer). These results are in confirmation with the findings of Jagdale *et al.* (2005). All the treatments of weed management showed significant improvement in growth attributes over unweeded during both the years of study. Higher values of all the growth attributes was recorded with the application of pendimethalin 1.0 kg/ha at early stages. After 30 DAS, higher values of growth attributes were recorded with the application of imazethapyr 37.5 g/ha during both the years.

Effect on yield attributes and yield

Different fertility levels produced significant impact on yield attributes and yield of lentil over control (Table 2). Significantly higher number of pods/plant, seeds/pod, test weight, grain yield and straw yield was recorded with the application of 75% RDF + Plantgro 9 kg/ha and it was at par with the application of 100% RDF + 2% urea spray during both the years. Higher straw yield was recorded with the treatment 100% RDF + Plantgro 9 kg/ha during the first year and 100% RDF + 2% urea spray during the second year. These results were similar with the findings of Singh *et al.* (2014). However, all the fertility levels proved significantly superior over control in increasing grain yield, straw yield and harvest index. Varying weed management treatments showed significant enhancement of yield attributes and yield over control during both the years. Among herbicide treatments, highest number of pods/plant, seeds/pod, test weight, grain yield, straw yield and harvest index was recorded with the application of imazethapyr 37.5g/ha and are in agreement with the findings of Chaudhary *et al.* (2011).

Quality attributes

Nutrient uptake is a function of dry weight and nutrient content is expected to follow the trend of dry weight influenced by the content. Weed control treatments brought about significant variation in

Table 2. Growth attributes, yield attributes, yield and B:C ratio of lentil as influenced by varying fertility levels and weed management treatments (pooled mean of two years)

Treatment	Growth attributes ^a			Yield attributes			Yield		Harvest index (%)	B:C ratio
	Plant height (cm)	Branches/plant	Dry matter accumulation (g/m ²)	No. of pods/plant	No. of seeds/pod	Test weight (g)	Grain (t/ha)	Straw (t/ha)		
<i>Fertility levels</i>										
100% RDF	16.52	4.90	24.36	57.42	1.85	23.00	1.09	1.97	35.94	2.37
75% RDF+ 2% urea spray at pre-flowering and pod initiation	18.02	5.27	26.20	54.68	1.82	22.40	1.03	1.99	34.04	2.11
75% RDF + plantgro 9 kg/ha at 35, 50, 65 DAS as foliar spray	18.40	5.61	27.71	62.26	1.98	25.20	1.28	2.14	37.96	2.00
100% RDF + 2% urea spray at pre-flowering and pod initiation	18.88	5.97	28.97	58.79	1.87	23.65	1.14	2.36	32.82	2.29
100% RDF + Plantgro 9 kg/ha at 35, 50, 65 DAS as foliar spray	19.44	6.22	30.22	45.43	1.78	21.40	1.03	2.31	30.84	1.62
Control	14.35	4.55	21.29	34.18	1.73	20.29	0.99	1.80	33.19	2.19
LSD (p=0.05)	0.75	0.24	1.55	2.67	0.06	1.27	0.06	0.10	1.40	-
<i>Weed management</i>										
Pendimethalin 1.0 kg/ha as pre-emergence	17.43	5.40	25.74	53.74	1.79	22.28	1.04	2.10	33.48	2.16
Imazethapyr 37.5 g/ha as post-emergence	18.00	5.71	27.53	55.75	1.86	23.14	1.09	2.12	33.92	2.35

^aObservation recorded at 60 DAS

Table 3. Protein yield, nutrient depletion by weeds and nutrient uptake of lentil after harvest as influenced by varying fertility levels and weed management treatments (pooled mean of two years)

Treatment	Protein yield (kg/ha)	Nutrient depletion by weeds (kg/ha)			Nutrient uptake by crop (kg/ha)		
		N	P	K	N	P	K
<i>Fertility levels</i>							
100% RDF	249.7	9.23	1.73	7.04	98.00	14.14	37.03
75% RDF + 2% urea spray at pre-flowering and pod initiation	231.0	9.86	1.90	7.72	89.09	11.15	32.16
75% RDF + Plantgro 9 kg/ha at 35, 50, 65 DAS as foliar spray	313.0	7.39	1.34	5.62	118.89	17.06	50.80
100% RDF + 2% urea spray at pre-flowering and pod initiation	266.2	9.03	1.65	6.76	114.49	16.61	43.70
100% RDF + Plantgro 9 kg/ha at 35, 50, 65 DAS as foliar spray	227.0	11.26	2.11	8.58	95.34	11.61	29.05
Control	188.6	13.80	2.61	10.73	71.09	6.80	16.47
LSD (p=0.05)	8.1	0.87	0.19	0.62	6.97	1.07	3.51
<i>Weed management</i>							
Pendimethalin 1.0 kg/ha as pre-emergence	228.2	10.46	1.97	7.65	94.40	11.56	30.68
Imazethapyr 37.5 g/ha as post-emergence	249.0	8.44	1.52	6.21	99.87	12.97	33.63
Unweeded	198.4	21.48	4.07	17.10	78.59	9.80	21.61
Weed free	308.1	0.00	0.00	0.00	118.42	17.26	53.57
LSD (p=0.05)	6.6	0.49	0.11	0.38	4.04	0.52	1.89

protein yield and N, P, K uptake by lentil during both the years (**Table 3**). All the weed control treatments were significantly superior to unweeded control in recording higher nutrient uptake by crop. Nutrient uptake (kg/ha) by crop was obtained significantly higher under the treatments 75% RDF + Plantgro 9 kg/ha followed by 100% RDF and 100% RDF + 2% urea spray for nutrient uptake.

All the treatments were found significantly superior over weedy check in recording higher nutrient uptake and protein yield by the crop at harvest stage. Among the weed management treatments, higher protein yield and N, P, K uptake (kg/ha) was recorded with the application of imazethapyr 37.5 g/ha.

It was concluded that application of 75% RDF along with PlantGRO 9 kg/ha (foliar spray at 35, 50 and 65 DAS) and imazethapyr 37.5 g/ha (post-emergence) showed best treatment for control of weeds and enhanced performance of lentil.

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