EFFECT OF SPLIT APPLICATION OF NITROGEN AND INTEGRATED WEED MANAGEMENT ON NUTRIENT UPTAKE BY *TRIANTHEMA PORTULACASTRUM* (*ITSIT*) IN COTTON

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A field experiment was conducted for two consecutive years to estimate the uptake of NPK by *Trianthema portulacastrum* (*Itsit*) in cotton. N @170 kg ha^{-1} was applied in three splits. Six weed control treatments were: two hoeings at 3 and 6 weeks after sowing (WAS); one hoeing at 3 WAS + one earthing-up at 6 WAS; S. metolachlor @ 2.4 kg a.i. ha^{-1} pre-plant incorporation (PPI); S. metolochlor @ 2.4 kg a.i.ha^{-1} PPI + one hoeing at 6 WAS and S. metolochlor @ 2.4 kg a.i. ha^{-1} PPI + one earthing-up at 6 WAS; along with a weedy check. Effect of split application of N and weed control methods on NPK concentrations in *Itsit* was non-significant but significant on uptake of NPK. Maximum nutrient uptake by *Itsit* was 36.16 kg ha^{-1} N, 7.79 kg ha^{-1} P and 41.57 kg ha^{-1} K in the weedy check. S. metolochlor @ 2.4 kg a.i.ha^{-1} with one earthing up at 6 WAS performed best in reducing the dry weight and NPK uptake by *Itsit.* Although the concentration of NPK in the weed was non-significant but uptake was significant mainly due to rapid growth and more dry matter accumulation during short available chance of growth period.
Key words: *T. portulacastrum*, NPK uptake, N splits, weed control methods

INTRODUCTION

Weeds are one of the major pests in cotton (*Gossypium hirsutum* L.). Weeds compete with crop plants for moisture, light and nutrients (Nam-il *et al*., 2001), and can cause significant economic loss (Swanton *et al*., 1993). Uncontrolled weeds can remove a significant amount of nutrients (Ibrahim *et al*., 1991) which otherwise can be utilized by crop plants for their growth and development. The level of nutrient loss depends not only on the infestation but also on the composition of weed flora. Many research workers have reported varying concentrations and uptake of NPK in different weed species (Zimdahl, 1993; Singh *et al*., 1996; Kavimani *et al*., 2001; Mandal, 2000). Weeds which stay in the field for a longer period of time absorb more nutrients (Velayutham *et al*., 2001).

Nutrients uptake by unchecked weeds are usually more than that by cotton but under chemical or cultural weed control methods the uptake of nutrients by cotton plant increases (Kelayniamam & Halikatti, 2002). Control of weeds by chemical or cultural practices is essential to avoid losses caused by weeds. Effect of weed control practices on crop growth can be enhanced by combining these practices into a system, leading to a synergistic improvement in control. For example, combining two of the cultural practices viz., N banding, narrow rows, or increased crop density reduce weed biomass by 25 to 30% (Anderson, 1999). Similarly, hand-weeding in combination with herbicide application has been found very effective for minimizing nutrient losses and for maximizing yield (Singh *et al*., 1996). As weeds compete for water and nutrients applied to the crop, there is a need to determine the proper stage of N application and weed control practice, which may reduce the nutrient uptake by weeds. Little is known about the nutrient losses by weeds in cotton. *Trianthema portulacastrum* (carpet weed), locally known as *Itsit* is one of the most important weeds of cotton having indeterminate growth habit and can produce seeds just in 3-4 weeks after germination. It grows from April to October and can produce seeds 3-4 times in its life cycle which can germinate in the same season.

The present study was designed to determine uptake of NPK by *T. portulacastrum* (*Itsit*) under integrated weed management system in cotton fertilized with N in three splits.

MATERIALS AND METHODS

A field experiment was conducted during 1999-2000 and 2000-2001 at the Agronomic Research Area, University of Agriculture, Faisalabad, Pakistan. The soil was sandy loam in texture, low in organic matter

(0.90-0.97%) and thus low in nitrogen (0.05%), and low in available P (13.5-14.0 mg kg $^{-1}$) but adequate in extractable K (193-197 mg kg^{-1}). Seedbed was prepared with 4 ploughings and 3 plankings. Cotton cultivar “CIM-443” was sown on 22nd May in 1999 and 24th May in 2000, having row spacing of 75 cm and plant spacing of 30 cm. The crop was sown with a single row hand drill. The experimental plot consisted of 6 m long 4 rows of cotton. Recommended doses of nutrients, viz 170 kg N ha^{-1} and 57 kg P_2O_5 ha^{-1} were applied. Total amount of P_2O_5 was side-dressed with the help of a single row hand drill at the time of sowing. Three nitrogen applications, viz, N_1= 25% at sowing + 50% at squaring + 25% at flowering (N_1); N_2= 25% at sowing + 25% at first irrigation + 50% at flowering (N_2); and N_3= 15% at sowing + 15% at first irrigation + 35% at squaring + 35% at flowering were randomized in main plots and six weed control methods i.e. W_2 =Two hoeings at 3 and 6 weeks after sowing (WAS); W_3 =one hoeing at 3 WAS and one earthing-up at 6 WAS; W_4=S. metolachlor (Dual gold, 960 g a.i. L^{-1}, Syngenta Pakistan Ltd.) @ 2.4 kg a. i. ha^{-1} pre-plant incorporate (PPI); W_5=S. metolachlor @ 2.4 kg a. i. ha^{-1} PPI + one hoeing at 6 WAS; W_6= S. metolachlor @ 2.4 kg ai. ha^{-1} PPI + one earthing-up at 6 WAS were randomized in sub-plots. Weedy check (W_1) was also included for comparison. The experiment was laid-out in a randomized complete block design with split plot arrangement in three replications. The basal dose of N as per treatment was side dressed with a single row hand drill at the time of sowing. Remaining doses of N were applied by side dressing method at their proposed time in the standing crop. S. metolachlor was sprayed after seedbed preparation with “Solo” hand sprayer fitted with a flat fan nozzle. Calibration was done to know the exact volume of water needed to spray herbicide. The herbicide was sprayed using a spray volume of 250 L ha^{-1} at 14 kpa pressure. The herbicide was incorporated manually in soil with a spade immediately after spray. Six irrigations, each of 7.5 cm depth were applied to the crop during the season.

Methamedaphos, Cyfluthrin + Methamedaphos (2 sprays), Biphenthrin and Immidachloprid were sprayed twice to protect the crop from insects. The above ground biomass of *Itsit* in each plot was assessed at maturity from a randomly positioned 1m^{-2} quadrat and oven dried at 80^{o}C for three days. These samples were ground and N, P and K concentrations were determined according to Tecator (1991) and Cottenie *et al*. (1979). NPK concentrations in *Itsit* were multiplied with its dry weight to calculate N, P and K uptake by *Itsit.*

Data collected were subjected to analysis of variance using the “MSTAT” package. Least significant difference test at 5 percent probability level was applied to test the significance of treatment means (Steel & Torrie, 1984).

RESULTS

Split N application had non-significant effect on NPK concentration in *Itsit* during both the years (Table-1). Nitrogen, P and K concentration in *Itsit* ranged between 1.17 to 1.43 %, 0.17–0.22 % and 1.62–2.02 %, respectively. Weed control methods significantly affected PK concentration in *Itsit* in 2000-2001 only with maximum P and K concentration of 0.23 and 1.90%, respectively.

Effect of split application of N on uptake of N and K by *Itsit* was non-significant (Table-2) but significant on uptake of P by *Itsit* with maximum value of 3.69 kg ha^{-1} when N was applied 25% at sowing + 25% at first irrigation + 50% at flowering (N_2). Weed control methods significantly decreased the uptake of N, P and K by *Itsit* during both the years (Table-2).

Interaction between split N application and weed control methods for uptake of N by *Itsit* was significant during 1999-2000. The maximum uptake of N by *Itsit* (29.64 kg ha^{-1}) was recorded from plot where N was applied as 25% at sowing + 25% at Ist irrigation + 50% at flowering and *Itsit* was allowed to grow throughout the crop growth period (N_2W_1). It was followed by split N application as 25% at sowing + 50% at squaring + 25% at flowering from weedy check plot (N_1W_1). Minimum uptake of N by *Itsit* (2.86 kg ha^{-1}) was recorded from plot where N was applied as 25% at sowing + 25% at Ist irrigation + 50% at flowering and S-metolachlor sprayed + one earthing up (N_2W_6).

The maximum uptake of P (2.45 kg ha^{-1}) by weeds was recorded from plot where N was applied 25% at sowing + 25% at Ist irrigation + 50% at flowering and *Itsit* was allowed to grow throughout the growth of cotton (N_2W_1). It was followed by N_1W_1 (Table-2). In the second year maximum uptake of P (8.06 kg ha^{-1}) by *Itsit* was observed from plot where N was applied as 25% at sowing + 50% at squaring + 25% at flowering and *Itsit* was not checked (N_1W_1). It was statistically similar with N and weed control combinations of N_2W_1, N_2W_4 and N_3W_1.

In 1999-2000, the maximum uptake of K (15.14 kg ha^{-1}) by *Itsit* was observed from weedy check plot followed by S-metolachlor @ 2.4 kg a.i. ha^{-1} treated plot (Table-2). The remaining weed control treatments were statistically similar in respect of uptake of K by *Itsit*. In the year 2000-2001, again *Itsit* in weedy check plot showed a maximum uptake of K (41.57 kg ha^{-1}) but did not differ significantly from S-metolachlor @ 2.4 kg a.i. ha^{-1} treatment.

Interaction between split application of N and weed control method was significant in 2000-2001 only. The data show that *Itsit* in weedy check plots with either of split N applications (N_1W_1, N_2W_1, N_3W_1) showed statistically similar uptake of K with a maximum value (42.49 kg ha^{-1}) in N_2W_1. These treatments did not differ statistically from S-metolachlor @ 2.40 kg a.i. ha^{-1} either with N application 25% at sowing + 25% at Ist irrigation + 50% at flowering (N_2W_4) or 15% N at sowing + 15% at Ist irrigation + 35% at squaring + 35% at flowering (N_3W_4).

Table 1. Dry weight, phosphorus and potash concentration of *Itsit* as affected by split application of N and weed control methods

Treatment	Dry weight of *Itsit* (gm^{-2})			Phosphorus concentration (%)			Potassium concentration (%)		
	1999-2000	2000-2001	Mean	1999-2000	2000-2001	Mean	1999-2000	2000-2001	Mean
A) Split N application (N)									
N_1	31.58^{a}	156.53^{b}	94.05^{b}	0.17	0.22	0.19	1.95	1.57	1.76
N_2	28.71^{b}	180.89^{a}	104.80^{a}	0.18	0.21	0.20	1.96	1.62	1.79
N_3	13.33^{c}	149.03^{b}	81.18^{c}	0.19	0.21	0.20	2.02	1.72	1.87
LSD 5%	2.57	20.09	8.41	NS	NS	NS	NS	NS	NS
B) Weed control methods (W)									
W_1	88.81^{a}	333.71^{a}	211.25^{a}	0.20	0.23 a	0.22 a	1.79	1.24 b	1.52 c
W_2	5.27^{c}	80.48^{d}	42.25^{d}	0.16	0.20 b	0.18 b	2.16	1.81 a	1.99 ab
W_3	3.51^{c}	111.09^{c}	57.30^{c}	0.18	0.20 b	0.19 b	1.73	1.78 a	1.76 bc
W_4	39.39^{b}	281.66^{b}	160.53^{b}	0.19	0.23 a	0.21 a	1.87	1.35 b	1.61 c
W_5	6.91^{c}	103.06^{c}	54.99^{c}	0.18	0.20 b	0.19 b	2.16	1.90 a	2.03 a
W_6	3.35^{c}	62.91^{d}	33.13^{d}	0.18	0.21 b	0.19 b	2.15	1.75 a	1.95 ab
LSD 5%	4.21	20.57	10.28	NS	0.01	0.01	NS	0.22	0.27
C) Interaction (N x W)				**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
N_1W_1	96.51^{b}	341.42^{a}	218.96^{a}						
N_1W_2	6.56^{gh}	3.57^{fgh}	40.07^{hi}						
N_1W_3	2.74^{b}	115.56^{cd}	59.15^{ef}						
N_1W_4	69.67^{c}	249.92^{b}	159.79^{cd}						
N_1W_5	12.29^{fg}	78.13^{efg}	45.21^{fghi}						
N_1W_6	1.69^{h}	80.59^{defg}	41.14^{ghi}						
N_2W_1	125.80^{a}	341.75^{a}	233.78^{a}						
N_2W_2	4.09^{h}	133.84^{c}	68.97^{c}						
N_2W_3	3.67^{h}	112.29^{cde}	57.98^{efg}						
N_2W_4	34.26^{e}	317.80^{a}	176.03^{bc}						
N_2W_5	1.12^{h}	140.05^{c}	70.59^{e}						
N_2W_6	3.29^{h}	39.61^{hi}	21.45^{j}						
N_3W_1	44.12^{d}	317.93^{a}	181.03^{b}						
N_3W_2	5.14^{gh}	34.04^{i}	19.59^{j}						
N_3W_3	4.13^{h}	105.42^{cdef}	54.78^{efgh}						
N_3W_4	14.24^{f}	277.28^{b}	145.76^{d}						
N_3W_5	7.31^{fgh}	91.01^{defg}	49.16^{fghi}						
N_3W_6	5.07^{gh}	68.52^{ghi}	36.80^{ij}						
LSD 5%	7.30	35.63	17.81						

DISCUSSION

The present study clearly indicates that split application of N did not affect N, P and K concentration in *Itsit* to a significant level. It was observed that *Itsit* germinated either after completion of weed control practices or those which escaped from herbicide, absorbed as much NPK as in weedy check.

The significant variation in uptake of N, P and K by *Itsit* in different weed control treatments was due to variation in its dry weight (Table 1). More N uptake by *Itsit* in plots sprayed with S-metolachlor @ 2.4 kg a.i. ha^{-1} than other weed control treatments indicate its poor control which caused more escape of weed. More uptake of NPK by *Itsit* in 2000-2001 than in 1999-2000 was due to more weed growth favoured by more rainfall which reduced the effects of weed control measures. Similar observations were noted by Ibrahim *et al.* (1991), Singh *et al.* (1996), Mandal (2000), Kavimani *et al*. (2001), Kelayniamam and Halikatti (2002) with integrated application of herbicide and hand weeding. The variation in uptake of NPK (2.46-3.06 kg N ha^{-1}, 0.30-12 kg P ha^{-1} and 39.17-41.57 kg K ha^{-1}) by weeds in previous studies and present study (0.15-36.56 kg N ha^{-1}, 0.02-8.06 kg P ha^{-1} and 0.64-41.50 kg K ha^{-1})can be attributed to varying weeds density, their type and growing conditions (Khalid, 1988)

Nitrogen, P and K losses by *Itsit* were less when S. metolachlor was sprayed in combination with one eathing-up at 6 WAS to control *Itsit.* This practice should be carried out to minimize nutrient uptake by *Itsit* in cotton.

REFERENCES

Table 2. Nitrogen, Phosphorus and potash uptake by *Itsit* as affected by split application of N and weed control methods

Treatment	Nitrogen uptake (kg ha^{-1})			Phosphorus uptake (kg ha^{-1})			Potassium uptake (kg ha^{-1})		
	1999-2000	2000-2001	Mean	1999-2000	2000-2001	Mean	1999-2000	2000-2001	Mean
A) Split N application (N)									
N_1	4.45	17.81	11.13	0.58 a	3.55 ab	2.06 b	5.45	22.43	13.93
N_2	4.85	20.13	12.50	0.55 a	3.96 a	2.26 a	4.73	26.60	15.67
N_3	1.79	17.87	9.83	0.27 b	3.32 b	1.80 e	2.79	23.32	13.06
LSD 5%	NS	NS	NS	0.10	0.47	0.18	-	-	-
B) Weed control methods (W)									
W_1	13.79 a	36.16 a	24.97 a	1.75 a	7.79 a	4.77 a	15.14 a	41.57 a	28.36 a
W_2	0.73 c	9.25 d	4.99 cd	0.08 c	1.62 de	0.85 d	1.16 c	14.70 bc	7.93 cd
W_3	0.47 c	13.78 c	7.13 c	0.07 c	2.23 c	1.15 c	0.64 c	19.82 b	10.23 c
W_4	5.72 b	31.10 b	18.41 b	0.71 b	6.60 b	3.66 b	6.82 b	38.07 a	22.45 b
W_5	1.00 c	13.35 c	7.17 c	0.11 c	2.12 cd	1.12 c	1.46 c	19.64 b	10.55 c
W_6	0.47 c	8.02 d	4.25 d	0.06 c	1.30 e	0.68 d	0.73 c	10.92 c	5.83 d
LSD 5%	2.72	3.97	2.36	0.12	0.51	0.25	3.25	5.43	3.10
C) Interaction (N x W)							**NS**	**NS**	**NS**
N_1W_1	13.54 b	36.56	25.05 b	1.90 b	8.06 a	4.98 a			
N_1W_2	0.93 ef	8.33	4.63 ef	0.10 ef	1.49 efg	0.79 fgh			
N_1W_3	0.42 f	12.27	6.34 ef	0.06 g	2.33 cde	1.20 def			
N_1W_4	9.83 bc	29.59	19.70 cd	1.20 c	5.96 b	3.58 c			
N_1W_5	1.74 def	9.94	5.84 ef	0.18 fg	1.70 ef	0.94 efg			
N_1W_6	0.23 f	10.19	5.21 ef	0.03 g	1.76 ef	0.90 fg			
N_2W_1	22.08 a	37.20	29.64 a	0.45 a	7.77 a	5.11 a			
N_2W_2	0.58 f	14.13	7.35 e	0.06 g	2.69 cd	1.38 de			
N_2W_3	0.45 f	14.69	7.57 e	0.07 g	2.28 cde	1.18 def			
N_2W_4	5.45 cde	33.60	19.52 cd	0.64 e	7.44 a	4.04 b			
N_2W_5	0.15 f	15.91	8.03 c	0.02 g	2.84 c	1.43 d			
N_2W_6	0.42 f	5.30	2.86 f	0.06 g	0.77 g	0.42 h			
N_3W_1	5.74 cd	34.71	20.23 e	0.90 d	7.55 a	4.23 b			
N_3W_2	0.68 f	5.28	2.98 f	0.09 fg	0.70 g	0.40 h			
N_3W_3	0.55 f	14.39	7.47 e	0.08 fg	2.09 cdef	1.08 defg			
N_3W_4	1.89 def	30.11	16.00 d	0.28 f	6.42 b	3.35 c			
N_3W_5	1.12 def	14.19	7.65 e	0.14 fg	1.83 def	0.99 efg			
N_3W_6	0.78 ef	8.56	4.67 ef	0.10 fg	1.36 fg	0.73 gh			
LSD 5%	4.72	-	5.83	0.20	0.87	0.44			

Means followed by the same letter in a column do not differ significantly at $P < 0.05$

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