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Growth analysis in cumin (*Cuminum cyminum* L.) under different weed control methods and nitrogen levels

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Abstract

A field experiment was conducted at Jobner (Rajasthan) to evaluate the effect of weed control and nitrogen application on growth and yield of cumin (*Cuminum cyminum*). The study revealed that two hand weedings done at 25 and 50 days after sowing (DAS) yielded maximum seeds (5.50 q ha^{-1}) which was 292.7% higher over control (with weeds). This treatment also attained maximum harvest index (40.7%), crop growth rate during 40–70 DAS and 70 DAS and relative growth rate during 40–70 DAS phase. Trifluralin @ 1.08 kg ha^{-1} (pre-plant incorporation) also increased seed yield by 252.9% which was the next superior herbicidal treatment with regard to yield and physiological parameters. Application of 45 kg N ha^{-1} was the most effective dose with regard to seed yield, crop growth rate and relative growth rate and was on par with 30 kg N ha^{-1}. Seed yield had a significant and positive association with growth, yield attributes and nutrient uptake by the crop.

Key words: cumin, *Cuminum cyminum*, growth, nitrogen, weed control, yield.

Introduction

Cumin (*Cuminum cyminum* L.) is widely grown in arid and semi-arid regions of Rajasthan and Gujarat in India. Rajasthan alone produces about 60% of the national production of cumin; however, the productivity (384 kg ha^{-1}) is very low among cumin growing states (Anon 2003). Heavy infestation of weeds during initial stages affects crop growth and also competes for moisture, nutrients, light and space and thus eventually reduces the yield to drastic levels (Malik & Bhan 1983). Little work has been done pertaining to use of dinitroaniline herbicides and their relation with yield and growth indices of cumin. Cumin is mostly cultivated on light textured soils which are generally deficient in nitrogen. In general, farmers do not apply nitrogen to cumin or when applied, it is in very low quantity, which results in poor growth and yield of the crop. Therefore, the present paper aims to report correlation and regression studies in cumin under different methods of weed control and levels of nitrogen.

Materials and methods

The study was carried out during *rabi* 2000-01 and 2001-02 at S K N College of Agriculture, Jobner (Rajasthan). The soil of the experimental field was loamy sand in texture,

alkaline in reaction, low in organic carbon and available nitrogen and medium in available phosphorus and potassium. The experiment was conducted in a split plot design and replicated thrice. The main plot treatments comprised of 10 weed control measures whereas, 3 levels of nitrogen (15, 30 and 45 kg ha^{-1}) were applied to sub-plots. Cumin variety RZ-209 was sown, keeping a row spacing of 30 cm. Uniform basal dose of 20 kg P_2O_5 ha^{-1} was drilled in all the plots of 4.0 m x 2.7 m size. Half dose of nitrogen (urea) was applied as basal dose and the remaining half was top dressed at full germination stage with first irrigation as per treatments. The herbicides trifluralin (0.72, 0.84, 0.96, 1.08 and 2.16 kg ha^{-1}) and fluchloralin (1.125 kg ha^{-1}) were incorporated prior to sowing as per treatments. Pendimethalin (1 kg ha^{-1}) was applied as pre-emergence treatment. In the plots earmarked for hand weeding, the operation was done at 25 and 50 days after sowing (DAS) as per treatments. Regular crop husbandry practices were followed to raise a good crop. Dry matter production was recorded at 40 DAS, 70 DAS and at harvest. The crop was harvested leaving two border rows each side (4.0 m x 1.5 m plot). Crop growth rate (CGR) and relative growth rate (RGR) were computed adopting standard procedures.

Results and discussion

Dry matter production

All the measures adopted for weed control produced significantly higher crop dry matter at all stages of growth when compared to control (Table 1). One hand weeding done at 25 DAS recorded the highest dry matter at 40 DAS stage whereas, at 70 DAS and at harvest, two hand weedings done at 25 and 50 DAS produced the maximum dry matter of 385.3 kg ha^{-1} and 1350.0 kg ha^{-1} at 70 DAS and at harvest, respectively. Each increase in level of trifluralin from 0.72 kg ha^{-1} resulted in significant improvement in dry matter accumulation up to 1.08 kg ha^{-1}. Trifluralin @ 1.08 kg ha^{-1} was the most effective herbicidal treatment which was on par with pendimethalin @ 1.00 kg ha^{-1} (pre-emergence). It increased the dry matter to 132.7% and 145.1% at 70 DAS and at harvest stages, respectively, over control. This improvement in crop dry matter might be due to the reduced weed crop competition rendered by these treatments. These results confirm the findings of Chaudhary & Gupta (1991). Application of nitrogen @ 30 kg ha^{-1} significantly enhanced dry matter production by 14.2%, 22.4% and 13.7% over 15 kg N ha^{-1} at 40 DAS, 70 DAS and harvest stages, respectively, which was statistically on par with 45 kg N ha^{-1}. Jangir & Singh (1996) also reported similar findings.

Physiological parameters

Physiological parameters like CGR during 0-40 DAS, 40-70 DAS and 70 DAS-harvest phases and RGR during 40-70 DAS phase were significantly influenced by weed control treatments (Table 1). Weedy check treatment recorded the lowest CGR and RGR values during all the growth phases. On the other hand, hand weeding once during 0-40 DAS and twice during 40-70 DAS and 70 DAS-harvest phases resulted in maximum CGR values of 0.089, 1.169 and 2.488 g m^{-2} day^{-1}, respectively and RGR of 79.75 mg g^{-1} day^{-1} between 40-70 DAS phase. Progressive increase in dose of trifluralin up to 1.08 kg ha^{-1} also resulted in significantly higher values of CGR between 40-70 DAS and 70 DAS-harvest phases and of RGR between 40-70 DAS phase which was the next better treatment in this regard. However, it was at par with trifluralin @ 0.84, 0.96, and 2.16 kg ha^{-1}, pendimethalin @ 1.00 kg ha^{-1}, fluchloralin @ 1.125 kg ha^{-1} and HW twice during 40-70 DAS and 70 DAS-harvest phases. The differences in RGR due to weed control treatments during 70 DAS-harvest phase were however not significant probably due to accelerated photosynthetic activity during 40-70 DAS phase and partitioning of assimilates more towards grain formation during reproductive phase (70 DAS-harvest). CGR during all three phases and RGR during 40-70 DAS also improved significantly due to increasing N level from 15 to 30 kg ha^{-1} but further increase did not result in significant improvement in these parameters.

Table 1. Effect of weed control and nitrogen levels on dry matter, crop growth rate, relative growth rate, seed yield and harvest index of cumin

Treatment	Crop dry matter (kg ha^{-1})			CGR (g m^{-2} day^{-1})			RGR (mg g^{-1} day^{-1})		Seed yield (q ha^{-1})	Harvest index (%)
	40 DAS	70 DAS	At harvest	0–40 DAS	40–70 DAS	70 DAS–harvest	40–70 DAS	70 DAS–harvest		
Weed control										
Weedy check (control)	24.33	152.98	502.87	0.061	0.429	0.874	60.63	30.02	1.40	27.65
Trifluralin @ 0.72 kg ha^{-1}	30.07	225.22	804.40	0.075	0.650	1.455	66.80	32.28	2.93	36.73
Trifluralin @ 0.84 kg ha^{-1}	33.09	280.98	987.60	0.083	0.826	1.775	71.08	31.82	3.75	38.39
Trifluralin @ 0.96 kg ha^{-1}	34.15	325.37	1122.15	0.085	0.971	2.000	75.21	31.22	4.42	39.54
Trifluralin @ 1.08 kg ha^{-1}	34.56	355.98	1232.47	0.086	1.071	2.195	77.73	31.27	4.94	40.42
Trifluralin @ 2.16 kg ha^{-1}	34.07	328.93	1190.55	0.085	0.098	2.156	75.54	32.45	4.85	40.59
Pendimethalin @ 1.00 kg ha^{-1}	34.74	350.68	1207.08	0.087	1.053	2.146	77.21	31.22	4.80	40.52
Fluchloralin @ 1.125 kg ha^{-1}	33.21	312.77	1116.02	0.083	0.932	2.011	74.69	32.17	4.39	40.51
HW once at 25 DAS	35.62	317.15	1158.55	0.089	0.938	2.107	72.71	32.88	4.54	40.63
HW twice at 25 and 50 DAS	34.74	385.30	1350.00	0.087	1.169	2.488	79.75	31.69	5.50	40.73
SEm ±	0.58	8.47	23.30	0.002	0.028	0.054	1.27	6.68	0.10	0.60
CD (P=0.05)	1.66	24.31	66.85	0.004	0.079	0.154	3.63	NS	0.28	1.72
Nitrogen level										
15 kg ha^{-1}	29.94	262.07	974.37	0.075	0.774	1.775	71.36	32.88	3.53	37.72
30 kg ha^{-1}	34.19	320.81	1107.60	0.085	0.955	1.976	73.98	31.16	4.43	39.11
45 kg ha^{-1}	34.45	327.72	1119.36	0.086	0.978	1.987	74.15	31.06	4.50	38.87
SEm ±	0.33	4.84	12.22	0.001	0.016	0.034	0.64	0.45	0.05	0.29
CD (P=0.05)	0.94	13.63	34.36	0.002	0.045	0.096	1.79	NS	0.15	0.82

CGR=crop growth rate; RGR=relative growth rate; HW=hand weeding

Seed yield and harvest index

Seed yield and harvest index were also affected by different weed control measures (Table 1). Two hand weedings done at 25 and 50 DAS surpassed all weed control treatments in seed yield (5.50 q ha^{-1}), increasing to 292.9% over control. It also recorded the highest harvest index of 40.7%. Pre-plant trifluralin @ 1.08 kg ha^{-1} proved the best herbicidal treatment producing a seed yield of 4.94 q ha^{-1}, though it was at par with trifluralin @ 2.16 kg ha^{-1} and pendimethalin @ 1.0 kg ha^{-1}. One hand weeding done at 25 DAS, fluchloralin @ 1.125 kg ha^{-1} and lower doses of trifluralin also increased seed yield significantly over control but were inferior to above mentioned treatments which might be due to the poor weed control achieved with these treatments. The lowest seed yield (1.40 q ha^{-1}) and harvest index (27.7%) were obtained under weedy check treatment. Similar results were also reported by Parihar & Singh (1994) and Gora *et al.* (1996). Application of 30 kg N ha^{-1} significantly increased the seed yield to 9.4% over 15 kg N ha^{-1} but it remained at par with 45 kg N ha^{-1} (Table 1). Similar results were also reported by Yadav & Jangir (1999).

Correlation and regression studies

Seed yield was significantly and positively correlated with crop dry matter, number of umbels $plant^{-1}$, number of umbellets and seeds $umbel^{-1}$, test weight and nitrogen and phosphorus uptake (Table 2). As such, increase or decrease in these attributes was associated with a similar increase or decrease in seed yield. The regression coefficients (b) and regression equations were also worked out to quantify the amount of change in seed yield of cumin for a unit change in growth and yield attributes and nutrient uptake by crop. The increase in seed yield due to each unit increase in crop dry matter at harvest, number of umbels $plant^{-1}$, number of umbellets and seeds $umbel^{-1}$ and test weight were 0.483, 58.030, 216.976, 42.163 and 586.085 kg ha^{-1}, respectively. Similarly, a unit increase in nitrogen uptake by seed and straw was associated with increase in seed yield of 33.708 and 81.772 kg ha^{-1} and for phosphorus uptake 152.837 and 229.266 kg ha^{-1}, respectively.

The study thus indicated that two hand weedings in cumin done at 25 and 50 DAS was the best weed control measure for obtaining maximum yield, growth indices and harvest index and pre-plant trifluralin @ 1.08 kg ha^{-1} was the most effective among herbicides; application of 30 kg N ha^{-1} was the most

Table 2. Correlation coefficients and regression equations for the relationship between seed yield and crop dry matter, yield attributes and nutrient uptake by cumin

Particulars	Correlation coefficient (r)	Regression equation
Crop dry matter at harvest (kg ha^{-1}) (X_1)	0.9993**	$Y = -1.00468 + 0.00483\ X_1$
Number of umbels $plant^{-1}$ (X_2)	0.9909*	$Y = -2.89871 + 0.58031\ X_2$
Number of umbellets $umbel^{-1}$ (X_3)	0.9029**	$Y = -6.72501 + 2.16976\ X_3$
Number of seeds $umbel^{-1}$ (X_4)	0.9705**	$Y = -6.06623 + 0.42163\ X_4$
Test weight (g) (X_5)	0.9391**	$Y = -22.82550 + 5.86085\ X_5$
N uptake by crop (kg ha^{-1}) (X_6)		
Seed	0.9993**	$Y = 0.28602 + 0.33708\ X_6$
Straw	0.9873**	$Y = -0.78291 + 0.81771\ X_6$
P uptake by crop (kg ha^{-1}) (X_7)		
Seed	0.9998**	$Y = 0.03869 + 1.52837\ X_7$
Straw	0.9920**	$Y = -1.59180 + 2.29266\ X_7$

Y=seed yield ; * Significant at 5% level; ** Significant at 1% level

remunerative dose for obtaining higher yield.

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