Indian Journal of Agronomy **45** (2) : 389–394 (June 2000)

Growth and productivity of summer sesame (*Sesamum indicum*) as influenced by biofertilizer and growth-regulator

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Reevied: August 1999

ABSTRACT

A field experiment was conducted during the summer season of 1996 and 1997 to study the effect of biofertilizer (buckup) and growth-regulator (electra, micrin and protein hydrolysate) on sesame (*Sesamum indicum* L.) on sandy-loam lateritic soil. Use of biofertilizer or growth-regulator alone did not influence the growth and yield attributes and yield of sesame over control, significantly. But combined application of biofertilizer and growth-regulator improved all the growth attributes and yield components and thus markedly increased grain and stick yields. Integrated use of buckup, electra and protein hydrolysate recorded the highest grain (1,094 kg/ha) and stick (2,392 kg/ha) yields of sesame and showed superiority to no or single application of biofertilizer or growth-regulator.

Key words : Sesame, Biofertilizer, Growth-regulator, Growth, Productivtiy

Sesame productivity in Indian is far below the World's, because it is grown mostly on poor and marginal lands under rainfed situation with little or no use of chemical fertilizer (Ninan, 1989). This is not because of its inability to make best use of the added nutrients but due to high cost of chemical fertilizers. In view of this, biofertilizer and growth-regulator may be the alternatives. These are not only cheaper but also renewable and pollution free. Beneficial effects of biofertilizer and growth-regulator on growth and productivity of different crops have been reported by several workers (Tomar *et al.*, 1996; Tripathy *et al.*, 1996). But no information is available on the effect of biofertilizer and growth-regulator on growth and productivity of sesame under lateritic belt of West Bengal, where sesame cultivation is gaining ground day by day. Hence the present investigation was undertaken.

MATERIALS AND METHODS

A field experiment was conducted during the summer season (March to May) of 1996 and 1997 at the farm of the

Institute of Agriculture (Palli Siksha Bhavana), Visva-Bharati, Sriniketan (23°39′ N, 87°42' E 58.9 m above mean sea-level. The soil of the experimental field was lateritic sandy loam (ultisol) having pH 6.2, total nitrogen 0.04%, available phosphorus 18.8 kg/ha and available potassium 146 kg/ha. The experiment was laid out in randomized block design with 8 biofertilizer and growth-regulator treatments (control, buckup 30 kg/ha, electra 2.0 litres/ha, micrin 2.0 litres/ha, protein hydrolysate 2.0 litres/ha, buckup + electra, buckup + electra + micrin and buckup + electra + protein hydrolysate) replicated thrice in 5 m × 3 m plots. Sesame 'Tilottama' ('B 67') was sown at 30 cm apart rows on first week of March during both the years. It received 25 kg/ha each of N, P_2O_5 and K_2O at sowing and another 25 kg N/ha 25 days after sowing (DAS). The crop received 3 irrigations at 7 DAS (after spraying of electra), braching (25 DAS) and at peak flowering (45 DAS) in 1996 and 2 irrigations at 7 DAS (after spraying of electra) and branching (25 DAS) in 1997 in addition to 139.2 mm and 182.8 mm rainfall in 1996 and 1997 respectively. One hand-weeding along with thinning was done at 24 DAS during both the years. Buckup (a biofertilizer containing vesicular arbuscular mycorrhizae and phosphate-solubilizing microorganisms in well-matured cow-dung manure) was applied at final land preparation and mixed thoroughly with soil. Electra (a liquid organic manure rich in electrolytes) was sprayed with 500 litres water at 7 days after sowing (DAS). Micrin (another liquid organic manure containing humic and fulic acids with 8.8% soluble soilds) and protein hydrolysate (a plant growth-regulator containing several amino acids) were sprayed over leaves @ 1.0 litre/ha each at 30 and 50 DAS. Obsevations on plant height, dry-matter accumulation, leaf-area index and crop-growth rate were recorded at different growth stages. Chlorophyll was estimated in the laboratory at 40 DAS. Number of branches/plant, capsules/plant, seeds/capsule, 1,000-seed weight along with seed and stick yields were recorded at maturity. Harvest index was estimated from seed and stick yields.

RESULTS AND DISCUSSION

Growth attributes

Use of biofertilizer or growth-regulator alone did not significantly increase branches/plant, plant height and leaf-area index at different growth stages of sesame over the control (Table 1). Single application of biofertilizer or growth-regulator also did not cause much effect on increasing the dry-matter production, crop-growth rate and chlorophyll content in leaves (Table 2). But combined application of biofetilizer and growth-regulator significantly increased all the above growth attributes over the control (no application of biofertilizer or growth-regulator). The highest values of all these growth attributes were recorded with combined application of buckup, electra and protein hydrolyaste which were significantly superior to those obtained with the control and single application of biofertilizer or growth-regulator. Increased nitrogenase activity by vesicular arbuscular mycorrhizae (Rajapakse and Miller, 1985), syn-

Table 1. Effect of biofertilizer and growth-regulator on branch production, plant height and leaf-area index at different stages in sesame (average data of 2 years)

Treatment	Branches/plant			Plant height (cm)	Leaf-area index (LAI)		
	Plant	40 DAS	60 DAS	80 DAS	40 DAS	60 DAS	80 DAS
Control	3.0	45.3	72.9	80.0	0.80	0.99	0.10
Buckup (30 kg/ha)	3.7	48.0	76.8	84.3	1.00	1.23	0.16
Electra (2.0 litres/ha)	4.1	48.6	78.2	86.5	0.96	1.20	0.14
Micrin (2.0 litres/ha)	4.3	51.0	79.4	87.0	0.98	1.24	0.12
Protein hydrolysate (2.0 litres/ha)	4.2	51.7	80.0	87.5	1.02	1.26	0.16
Bukup + electra	4.8	54.0	83.4	90.3	1.29	1.59	0.25
Buckup + electra + micrin	5.2	56.6	86.1	93.8	1.39	1.63	0.30
Buckup + electra + Protein hydrolysate	5.1	56.8	87.0	94.5	1.48	1.65	0.32
CD (P = 0.05)	1.5	7.7	7.4	7.8	0.26	0.29	0.11
CV (%)	11.8	5.2	3.2	3.0	8.2	7.5	20.5

Table 2. Effect of biofertilizer and growth-regulator on dry-matter accumulation, crop growth rate and chlorophyll content in leaf (average data of 2 years)

Treatment	Dry-matter production (g/m^2)			Crop-growth rate (g/m^2/day)		Chlorophyll content (mg/g)		
	40 DAS	60 DAS	80 DAS	40-60 DAS	60-80 DAS	Ch. a	Ch. b	Total
Control	81	176	251	4.75	3.75	0.76	0.56	1.32
Buckup (30 kg/ha)	102	224	300	6.10	3.80	0.77	0.59	1.36
Electra (2.0 litres/ha)	98	219	299	6.05	4.00	0.78	0.60	1.43
Micrin (2.0 litres/ha)	104	222	309	5.90	4.35	0.80	0.58	1.43
Protein hydrolysate (2.0 litres/ha)	110	225	320	5.75	5.15	0.83	0.62	1.45
Buckup + electra	125	267	372	7.10	5.25	0.92	0.70	1.78
Buckup + electra + micrin	134	289	412	7.75	6.15	0.95	0.72	1.80
Buckup + electra + protein hydrolysate	140	302	435	8.10	6.65	0.98	0.75	1.88
CD (P = 0.05)	33.0	61.0	72.8	1.86	1.68	3.08	0.07	0.15
CV (%)	10.2	8.8	7.5	10.2	12.0	3.4	3.6	3.2

thesis of growth-promoting substances by phosphate-solublizing bacteria (Gaur, 1990) and rapid-cell multiplication by the use of exogenous growth-regulator (Singaravel *et al.*, 1993) might be responsible for vigorous growth of the crop receiving both biofertilizer and growth-regulator.

Yield components

Yield components followed the trend

similar to that of the growth attributes (Table 3). Application of biofertilizer or growth-regulator alone did not cause much effect on increasing the capsules/plant, seeds/capsule and 1,000-seed weight over the control in none of the years under study. But combined use of biofertilizer and growth-regulator significantly increased all the above yield components of sesame over the control. The highest values of all the yield attributes were recorded with combined use of buckup, electra and protein hydrolysate which were significantly superior to those in the control and single treatments of either biofertilizer or growth-regulator during both the years. Vigorous growth of the crop with high leaf-area index acted over longer duration due to the integrated use of biofertilizer and growth-regulator were mainly responsible for increasing yield components of sesame. The results are in conformity with those of Chatterjee *et al.* (1985), Sontakey *et al.* (1991) and Tripathy *et al.* (1996).

Crop productivity

Application of biofertilizer or growth-regulator alone increased both the seed and stick yields of sesame over the control but the differences were not significant (Table 4). Significantly higher seed and stick yields over the control were recorded due to the integrated use of both biofertilizer and growth-regulator. Pooled analysis of 2 years data also revealed similar results. The highest seed and stick yields were obtained with combined application of buckup, electra and protein hydrolysate which were significantly superior to those obtained with no or single use of either biofertilizer or growth-regulator. However, the differences in seed and stick yields among the treatments consisting of both biofertiolizer and growth-regulator were not significant in any of the 2 years. The efficiency of the crop in partitioning photosynthate for seed development as reflected by harvest index did not very significantly among the treatments due to single or combined use of

Table 3. Effect of biofertilizer and growth-regulator on yield components of sesame

Treatment	Capsules/plant		seeds/capsule		1,000-seed weight (g)	
	1996	1997	1996	1997	1996	1997
Control	20.0	25.3	40.2	42.6	2.30	2.41
Buckup (30 kg/ha)	20.3	27.5	41.5	44.0	2.53	2.64
Electra (2.0 litres/ha)	21.0	29.0	42.3	45.8	2.49	2.60
Micrin (2.0 litres/ha)	22.6	29.4	43.6	47.0	2.50	2.62
Protein hydrolysate (2.0 litres/ha)	22.7	30.0	43.8	48.2	2.53	2.66
Buckup + electra	23.4	32.6	44.9	50.8	2.60	2.70
Buckup + electra + micrin	24.3	33.8	45.8	51.6	2.63	2.74
Buckup + electra + protein hydrolysate	25.0	35.0	46.6	52.8	2.65	2.76
CD (P = 0.05)	3.2	4.4	4.6	6.2	0.30	0.29
CV (%)	4.8	5.0	4.2	4.5	4.1	3.8

Table 4. Effect of biofertilizer and growth-regulator on sesame productivity

Treatment	Seed yield (kg/ha)			Stick yield (kg/ha)		Harvest index (%)	
	1996	1997	Pooled	1996	1997	1996	1997
Control	670	804	737	1,342	1,620	0.33	0.33
Buckup (30 kg/ha)	747	937	842	1,449	1,824	0.34	0.34
Electra (2.0 litres/ha)	750	920	835	1,375	1,797	0.35	0.34
Micrin (2.0 litres/ha)	753	945	849	1,505	1,906	0.33	0.33
Protein hydrolysate (2.0 litres/ha)	760	962	861	1,434	1,996	0.34	0.33
Buckup + electra	863	1,035	949	1,754	2,155	0.33	0.32
Buckup + electra + micrin	930	1,156	1,043	1,807	2,293	0.34	0.34
Buckup + electra + protein hydrolysate	963	1,224	1,094	1,849	2,392	0.34	0.34
CD (P = 0.05)	182	226	196	406	484	NS	NS
CV (%)	8.0	7.8	7.5	9.0	8.5	4.8	5.2

biofertilizer and growth-regulator. Vigorous growth of the crop along with higher leaf-area index for longer duration and higher chlorophyll content obtained with the use of biofertilizer and growth-regulator enabled the crop to bear more capsules/plant, seeds/capsule and more 1,000-seed weight which in turn resulted in higher crop productivity. The results corroborate the findings of Jung (1991), Singaravel *et al.* (1993) and Tripathy *et al.* (1996).

Thus the need of integrated use of biofertilizer and growth-regulator in additional to chemical fertilizer for improving and stabilizing the growth and productivity of sesame grown in summer season in the lateritic belt of West Bengal.

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