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Short Communication

Influence of drip irrigation and fertigation on seed yield and quality in okra

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Okra (*Abelmoschus esculentus* L.) popularly known as Bhindi, is an economically important vegetable crop grown in tropical and sub-tropical and in the warmer parts of temperate regions in India. The availability of irrigation water is dwindling day-by-day. Adoption of conventional methods of irrigation to crops leads to an acute scarcity of water and results in reduced production and productivity of crops. Therefore, it becomes imperative to go for alternate water saving methods by more crop and income for every drop of water. Drip fertigation enables accurate adjustment of water and nutrient supplies to meet the crop requirements [1-2]. Further, the fertigation is the most efficient method of fertilizer application [3]. The quality seed always have its influence on the productivity of commercial crop. Under the deficit irrigation sources, raising the seed production crop in drip irrigation is imperative to meet the seed demand. Hence, an attempt was made to study the influence of drip irrigation and fertigation on seed yield and resultant seed quality in Bhindi.

Field experiment was carried out in the Central Farm, Tamil Nadu Agricultural University, Coimbatore during 2010 *kharif* season adopting different irrigation and fertilizer schedules. The experiment was laid out in factorial randomized block design with three replications. The treatment details are as follows: T1: Furrow irrigation + 100 % recommended dose of fertilizer (RDF) as soil application; T2: Furrow irrigation + 75 % RDF as soil application; T3: Furrow irrigation + 125 % RDF as soil application; T4: Drip irrigation + 100 % RDF as soil application; T5: Drip irrigation + 75 % RDF as soil application; T6: Drip irrigation + 125 % RDF as soil application; T7: Drip fertigation with 100 % RDF; T8: Drip fertigation with 75 % RDF; T9: Drip fertigation with 125 % RDF.

For surface irrigation and drip irrigation treatments, the recommended dose of fertilizers was applied as soil application. In case of drip fertigation, phosphorus alone was applied as soil application and N & K were given through irrigation. Fertilizer sources used for supplying NPK were urea (46% N), single super phosphate (16 % P_2O_5) and muriate of potash (60% K_2O) respectively.

Fertigation was given during different stages of the crop growth periods *viz.*, (i) Sowing to crop establishment stage (6-10 days); (ii) Flower initiation to flowering stage (11-40 days); (iii) Flowering to fruit set (41-60 days) and (iv) Alternate days from picking (61-90 days). The observations on number of pods plant^{-1}, pod yield plant^{-1}, number of seeds pod^{-1}, seed yield plant^{-1}, pod to seed recovery (%) and graded seed recovery (%) (Seeds retained in the BSS 6 wire mesh sieve) were recorded. The graded resultant seed was subjected for the following seed quality characteristics *viz.*, 100 seed weight [4], speed of germination [5], germination percentage [4], root length, shoot length, dry matter production [6] and vigour index [7]. Data obtained in this study were subjected to statistical analysis [8].

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The aim of any applied research is to get maximum income in terms of increased yield. The yield attributing characters of Bhindi *viz.*, number of pods plant^{-1} (7.56), pod yield plant^{-1} (65.78g), seed yield plant^{-1} (33.56g), pod to seed recovery (50.61%), graded seed recovery (98.60%) and 100 seed weight (6.8g) (Table 1) were significantly influenced by drip irrigation regimes and fertigation levels. Among the irrigation methods, drip fertigation and drip irrigation found to be better than that of conventional irrigation (or) furrow irrigation. The yield attributing characters were higher under drip fertigation with 100% RDF. The higher seed yield per plant, 100 seed weight and graded seed recovery percentage might be due to the higher availability of required nutrients in soil solution through fertigation. The drip fertigation has helped the plants to utilize the nutrients from the rhizosphere more efficiently in comparison to drip or conventional methods. As drip fertigation improves the availability of nutrients, slowly, steadily and in suitable proportions, the crop has taken up all the three macronutrients more effectively, which resulted in progressive growth changes in the crop. Since the nutrient release was gradual, the crop appeared to be extended in terms of growth and reproductive patterns.

In addition, the higher uptake of nutrients during different stages of growth paved way for better photo assimilation and better translocation of assimilates from source

Table 1. Influence of drip irrigation and drip fertigation on seed yield

Treatments	Number of pods plant^{-1}	Pod yield plant^{-1} (g)	Seed yield plant^{-1} (g)	Pod to seed recovery (g)	Seed grading (BSS 6)	100 seed weight
T1 - Furrow irrigation + 100% RDF as soil application	5.20	36.40	23.50	43.75 (41.41)	78.50 (62.37)	4.8
T2 - Furrow irrigation + 75% RDF as soil application	5.21	38.03	24.60	43.83 (41.45)	81.30 (64.37)	5.2
T3 - Furrow irrigation + 125 % RDF as soil application	5.45	40.33	25.70	45.38 (42.35)	76.00 (60.66)	5.2
T4 - Drip irrigation + 100 % RDF as soil application	5.42	42.27	26.34	45.73 (42.55)	73.30 (58.88)	5.5
T5 - Drip irrigation + 75 % RDF as soil application	5.46	44.77	26.78	43.71 (41.38)	73.30 (58.88)	5.7
T6 - Drip irrigation + 125 % RDF as soil application	5.59	47.51	27.87	46.49 (42.98)	72.00 (58.05)	5.9
T7 - Drip fertigation with 100 % RDF	7.56	65.78	33.56	50.61 (45.35)	98.60 (83.20)	6.8
T8 - Drip fertigation with 75 % RDF	5.85	55.78	30.45	50.56 (45.32)	80.00 (63.43)	6.3
T9 - Drip fertigation with 125 % RDF	6.78	62.65	32.76	50.39 (45.22)	81.40 (64.45)	6.5

to sink which might have enhanced the better filling of seeds, thus resulting in increased seed weight and which obviously led to increase the yield. Similar responses were obtained in gherkins under drip fertigation [9] and in radish [10].

The increased seed yield might be due to increased flower bud production reflecting on enhanced meristematic activity, which resulted in more pods plant[1]. This might be due to increased photosynthetic activity causing higher accumulation of metabolites, with direct impact on pod weight, which created conditions more favourable for physiological processes [11] in Bhindi. The availability of potassium one of the major nutrients closely associated with the efficiency of leaves in assimilating carbon dioxide and translocation of photosynthates [12].

Seed quality parameters exhibited significant differences due to fertigation levels. Speed of germination (10.4), seed germination (89.33%), root length (16.14cm), shoot length (15.39cm), dry weight of seedlings (0.554g) and vigour index (2800) were significantly highest in drip fertigation with 100 % RDF (Table 2).

Table 2. Influence of drip irrigation and drip fertigation on resultant seed quality

Treatments	Speed of germination	Germination	Root length (cm)	Shoot length (cm)	Dry matter production (g seedlings^{-10})	Vigour index
T1 - Furrow irrigation + 100 % RDF as soil application	8.3	81.33 (64.40)	14.47	12.72	0.270	2211
T2 - Furrow irrigation + 75 % RDF as soil application	8.5	82.66 (65.39)	14.59	13.44	0.368	2316
T3 - Furrow irrigation + 125 % RDF as soil application	8.8	84.00 (66.42)	14.77	13.58	0.399	2381
T4 - Drip irrigation + 100 % RDF as soil application	9.5	80.00 (63.43)	14.88	13.91	0.428	2303
T5 - Drip irrigation + 75 % RDF as soil application	9.3	82.66 (65.39)	14.96	14.02	0.436	2395
T6 - Drip irrigation + 125 % RDF as soil application	9.1	84.00 (66.42)	15.02	14.11	0.463	2446
T7 - Drip fertigation with 100 % RDF	10.4	89.33 (70.93)	16.14	15.39	0.554	2800
T8 - Drip fertigation with 75 % RDF	10.1	86.66 (68.57)	15.61	14.91	0.528	2644
T9 - Drip fertigation with 125 % RDF	9.8	88.00 (69.73)	15.13	15.21	0.536	2685
SE(d)±	0.247	2.212	0.396	0.371	0.011	64.515
CD (p=0.05)	0.520	4.648	0.832	0.781	0.024	135.54

(Figures in parenthesis are arcsine values)

Significant increase in the seed quality parameters may be due to higher recovery of graded seeds with 100 seed weight as evident from this study, which might have produced more number of heavier and bolder seeds contributing to better seed quality. These results are in confirmation with the reports in chilli [13-14], okra [15] and brinjal [16].

The stimulatory effect of nitrogen on seed germination might be attributed to better translocation of assimilates from source to sink as discussed in elsewhere and due to the initial capital theory [17]. The increased quantity of mitochondrial protein of seedlings produced heavy seed is indicative of a higher respiratory rate and a greater amount of energy (ATP) production, which gives heavier seed a greater potential than that of lighter seed [18].

The continuous availability of major nutrients namely phosphorus and potassium at the critical stage of seed development and maturation played a vital role in seed quality, as the key elements responsible for the ATP synthesis and activation of respiratory enzymes, ATPase and other enzymes involved in the biosynthesis of seed [19-20]. This might have been contributed for the better seed quality characteristics.

Considering the seed yield and quality, the drip fertigation with 100% (or) 125% recommended dose of fertilizer might be suggested for harvesting higher yield of quality seed in okra.

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