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B Mishra

Department of Vegetable
Science, College of Agriculture,
OUAT, Bhubaneswar, Odisha,
India

GS Sahu

Department of Vegetable
Science, College of Agriculture,
OUAT, Bhubaneswar, Odisha,
India

P Tripathy

Department of Vegetable
Science, College of Agriculture,
OUAT, Bhubaneswar, Odisha,
India

S Mohanty

Department of Soil Science,
College of Agriculture, OUAT,
Bhubaneswar, Odisha, India

B Pradhan

Department of Plant Breeding
and Genetics, College of
Agriculture, OUAT,
Bhubaneswar, Odisha, India

Corresponding Author:**B Mishra**

Department of Vegetable
Science, College of Agriculture,
OUAT, Bhubaneswar, Odisha,
India

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Effect of integrated nutrient management on disease and pest incidence and yield of okra (*Abelmoschus esculentus* (L.) Moench)

B Mishra, GS Sahu, P Tripathy, S Mohanty and B Pradhan

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Abstract

A field experiment was conducted at the instructional farm of Krishi Vigyan Kendra Jajpur, Odisha during 2016 to study the effect of integrated nutrient management on disease and pest incidence and yield of okra (*Abelmoschus esculentus* (L.) Moench) variety Pusa A-4.

From the experiment it was observed that treatment T₇ [RDF(75%)+ (25%) neem oil cake] has significant effect on disease incidence and pest population by reducing incidence of YVMV from 32.42% to 19.56%, jassid population from 11.57 to 6.53 per three leaves, mite population from 11.98 to 8.11 per three leaves, white fly population from 13.61 to 6.64 per three leaves and fruit borer from 17.94 % to 7.94 %. Maximum number of fruits per plant 15.02 was recorded in T₇. Fruit yield per hectare varied significantly and was maximum with T₇ (10.49 ton) and was minimum with T₁₁ (7.30 ton). T₇ (10.49 ton) and T₅ (9.85 ton) and T₁₀ (9.65 ton) were at par with each other. Combined use of 75 % RDF as inorganic fertilizer with 25 % RDF through neem oil cake (T₇) recorded highest gross income of Rs.1,45,770/-, net income Rs.85,458 /- per hectare and maximum benefit cost ratio 2.42.

Keywords: Neem oil cake, Vermicompost, Disease and pest incidence, INM system, yield and Okra

Introduction

Okra, (*Abelmoschus esculentus* (L.) Moench) belongs to family Malvaceae (2n= 130) is cultivated in 0.509 Mha area with production of 6.09 MT in India (NHB,2017-18). It is a popular fruit vegetable grown round the year and fetches premium price in the market. The leading okra producing states in India are Uttar Pradesh, Bihar, Odisha, West Bengal, Andhra Pradesh and Karnataka. The major diseases and pests of okra are yellow Vein Mosaic Virus (YVMV) transmitted by white fly (*Bemisia tabaci* Genn.), jassid, mite, fruit borer (*Earias vittella* Fabr.) causing extensive damage to okra fruits. and cause loss in marketable fruit yield. Injudicious use of chemical fertilizers increased the incidence of pests and diseases. Therefore, it is felt necessary to reduce the environmental risk as well as human health hazards by reducing the levels of inorganic fertilizers level with adoption of suitable combinations of organic and inorganic fertilizers under integrated nutrient management system. Hence, the present experiments was conducted to study the effect of integrated nutrient management system on incidence of major disease and pests, yield and economics of okra.

Materials and Methods

A field experiment was conducted at the instructional farm of Krishi Vigyan Kendra Jajpur situated at Badachana which is 65 km. away from Odisha University of Agriculture and Technology, Bhubaneswar during 2016. The experiment was conducted to study the effect of integrated nutrient management practices on incidence of disease, pest and yield of okra var. Pusa A4. The experiment was laid out in randomized block design (RBD) with three replications and twelve treatments. Treatments involved were T₁ (100% RDF), T₂ (100% RDF + FYM 1.5 t / ha), T₃ (RDF (75%)+Azotobacter+Azospirillum+ PSB (2kg/ha each), T₄ (RDF (75%) + (25%) N through FYM), T₅ (RDF (75%)+(25%) N through vermicompost), T₆ (RDF (75%) + (25%) N through poultry manure), T₇ (RDF (75%)+(25%) N through neem oil cake), T₈ (RDF (50%) + (25%) N through FYM+(25%) N through vermicompost), T₉ (RDF(50%)+(25%) N through FYM+(25%) N through poultry manure),

T₁₀ (RDF (50%)+(25%) N through FYM+(25%) N through neem oil cake), T₁₁ (25% N through FYM + 25% N through vermicompost + 25% N through poultry manure+25% N through neem oil cake), T₁₂ (25% N through FYM + 25% N through vermicompost + 25% N through poultry manure+25% N through neem oil cake + sea weed extract 15kg/ha) where RDF was recommended dose of fertilizers (110:50:80 NPK kg/ha.) The land was brought to a fine tilth through ploughing and tillage. Irrigation channels and bunds were prepared according to layout. The seeds were soaked overnight and sown in the field directly. Light irrigation was given just after sowing of seeds. Organic manures were applied one week before sowing. Full dose of phosphorus, potassium and half dose of nitrogen as per treatments were applied just before sowing. The remaining half dose of nitrogen was applied twenty five days after sowing. All cultural practices were followed regularly during crop growth and observations were recorded on yield, yield attributing characters, disease incidence and pest populations. Jassid, white flies, mites counts were made on three leaves (top, middle and bottom) per plant of five randomly selected plants of each plot. The insects population was recorded at 20,30,40 and 50 days after sowing (DAS). Observations on incidence of YVMV were recorded at 15 days interval starting from 20th DAS to final harvesting of fruits. The fruits harvested at each picking in the individual plots were counted for borer and healthy fruits and their weights recorded separately and percent infestation was worked out. The data on these parameters were subjected to statistical analysis to draw logical conclusions.

Results and Discussion

From the experiment it was observed that population of jassids was lowest (6.53 nymphs per three leaves) in T₇ where 75 % of RDF through inorganic fertilizer and 25 % through neem oil cake were applied whereas, highest population (11.57 nymphs per three leaves) was recorded in T₂ where 100% RDF + FYM 1.5 t / ha were applied. Comparatively lower population were also found in treatment T₁₀ (6.76 nymphs per three leaves) where RDF (50 %) + 25 % FYM + 25 % neem oil cake were applied and in T₅ (7.16 nymphs per three leaves) were recorded where 75 % RDF through chemical fertilizers + 25 % vermicompost were applied. The present findings corroborate with the findings of Kavitha Raghavan *et al.* (2005) ^[9] who reported that soil application of FYM (12.5 t/ha) followed by neem cake (1000 kg/ha) in 3 split was found consistently effective in reducing the incidence of Jassid. However, Mandal *et al.* (2006) ^[16] reported that soil application of neem cake 200 kg ha⁻¹ along with three foliar sprays of endosulphan 35 EC @ 0.5 mg ha⁻¹ after 20, 40, 60 days of crop emergence reduced jassid population 6.8 per 30 leaves.

Application of 75 % RDF through inorganic fertilizer + 25 % through neem oil cake fertilizer (T₇) significantly reduced the white fly population from 13.61 to 6.64 per three leaves. Maximum population of 13.61 per three leaves was recorded in the treatment T₂ (100% RDF+ FYM 1.5 t / ha) whereas, minimum population of 6.64 per three leaves was found in T₇. However, population of whitefly was also found less in T₁₀ (6.89 per three leaves) where 50 % RDF + 25 % FYM + 25 % neem oil cake were applied and. T₅ (7.24 per three leaves) were recorded where 75 % RDF through chemical fertilizers + 25 % vermicompost were applied. Similar type of result were reported by Joshi M.D. (2011) ^[8] that application of 75 % RDN through neem oil cake + 25% through chemical

fertilizer lowered white fly population (2.23 white fly per three leaves per plant). This was also reported at par with treatment where 75 % RDN through poultry manure + 25 % chemical fertilizer were applied (2.61 white fly per three leaves per plant). Adilakshmi *et al.* (2008) ^[11] recorded that application of 75 % RDF from neem oil cake and 25 % RDF from chemical fertilizers significantly lowered white files population 2.37 per three leaves per plant.

Mite population was found to be minimum in T₇ (8.11 mites per three leaves per plant) receiving 75 % RDF through inorganic fertilizer and 25 % through neem oil cake. It was found to be at par with T₁₂ (8.56 mite per three leaves per plant) where, (25% N through FYM + 25% N through vermicompost + 25% N through poultry manure+25% N through neem oil cake + sea weed extract 15kg/ha) were applied, T₁₁(8.84 mite per three leaves per plant) where 25 % FYM + 25 % vermicompost + 25 % poultry manure + 25 % neem oil cake were applied, T₁₀ (8.85 mite per three leaves per plant) where 50 % RDF through chemical fertilizer + 25 % through FYM + 25 % through neem oil cake were applied and T₅ (9.12 mite per three leaves per plant) where 75 % RDF + 25 % vermicompost were applied. Whereas, maximum mite population was recorded in T₂ (11.98 per three leaves per plant). Similar type of result were reported by Joshi (2011) ^[8] where application of 75 % RDN through neem oil cake + 25 % through chemical fertilizer significantly lowered population of mite (1.14 mite per three leaves per plant). and it was at par with treatment where 75 per cent of RDN were applied through poultry manure (1.45 mites per 3 leaves per plant) and vermicompost (1.72 mites per three leaves per plant) and 25 per cent through chemical fertilizer. Similar observations were also reported by Mahto and Yadav (2009) ^[13].

Significantly lower fruit infestation (7.94 %) was found in treatment T₇ where 75 % RDF through chemical fertilizer + 25 % through neem oil cake were applied. whereas, highest fruit infestation (17.94 %) was occurred in T₂ where 100% RDF + FYM 1.5 t / ha were applied. All other treatments differed significantly so far as fruit borer infestation was concerned. Similar type of result was also reported by Adilaxmi *et al.* (2008) who found that minimum shoot and fruit borer damage percentage (2.37%) was observed in the field receiving treatment 75 % RDF from neem oil cake and 25 % RDF from chemical fertilizer. Minimum fruit infestation (2.43 %) due to fruit borer in okra was observed in the treatment where 75 % RDN was supplied through neem oil cake and 25 % through chemical fertilizer. However, it was at par with the treatment where 75 % RDN through poultry manure combined with 25 % through chemical fertilizer were applied (3.03 %). (Joshi, 2011) ^[8].

Considering the disease intensity of yellow vein mosaic in the present experimental trial, the treatment (T₇) where 75 per cent RDF applied through chemical and 25 per cent through neem oil cake recorded significantly minimum disease intensity (19.56 %). This was at par with T₁₂ (20.52 %) where (25% N through FYM + 25% N through vermicompost + 25% N through poultry manure+25% N through neem oil cake + sea weed extract 15kg/ha) were applied. Maximum yellow vein mosaic virus infestation was recorded in T₂ (32.42 %) where 100% RDF + FYM 1.5 t / ha were applied. The present findings corroborate with the findings of Tripathy *et al.* (2008) ^[21] in which application of reduced level of 50 % RDF @ 150:100:80 kg ha⁻¹ + biofertilizer + organic manure in the form of neem cake (both @ 1.25 and 2.5 t ha⁻¹ or vermicompost @ 2.5 t/ha significantly reduced YVMV infestation in okra. However, Joshi (2011) ^[8] observed that

application of 75 % RDN through neem oil cake and 25 % through chemical fertilizer significantly reduced disease intensity (15.02 %). Also Adilakshmi *et al.* (2008) [1] has reported the effectiveness of neem oil cake against the yellow vein mosaic vector on okra. This might have attributed due to presence of triterpenoids in neem cake, which has insecticidal

property (Godase and Patel, 2003) [7]. The better efficiency of neem cake might be due to the presence of "Azadirachtin" associated with Nimbin, Nimbidin, Salonine etc, which have multifarious activities such as insect repellent, feeding oviposition deterrent, growth regulatory effect, direct toxicity etc. (Plant Horticulture Technology, 2002) [18].

Table 1: Pest population as influenced by integrated nutrient management in okra

Treatments		*Jassid (no.)	*Whitefly (no.)	*Mite (no.)	** fruit borer (%)	**YVMV (%)
T ₁	100% RDF	11.39 (3.45)	13.58 (3.75)	11.84 (3.51)	17.79 (24.94)	32.36 (34.67)
T ₂	100% RDF + FYM (1.5 t / ha)	11.57 (3.47)	13.61 (3.76)	11.98 (3.53)	17.94 (25.06)	32.42 (34.71)
T ₃	RDF (75%) + <i>Azotobacter</i> + <i>Azospirillum</i> + PSB (2kg/ha.each)	8.72 (3.04)	11.77 (3.50)	10.24 (3.28)	17.94 (25.05)	26.48 (30.97)
T ₄	RDF (75%)+(25%)FYM	9.27 (3.13)	10.92 (3.38)	9.86 (3.212)	15.86 (23.46)	27.76 (31.79)
T ₅	RDF (75%)+(25%) VC	7.16 (2.77)	7.24 (2.78)	9.12 (3.10)	10.19 (18.58)	23.24 (28.82)
T ₆	RDF (75%)+(25%) PM	8.71 (3.03)	9.86 (3.22)	9.88 (3.22)	14.59 (22.45)	26.16 (30.76)
T ₇	RDF (75%) + (25%) NOC	6.53 (2.65)	6.64 (2.67)	8.11 (2.93)	7.94 (16.36)	19.56 (26.25)
T ₈	RDF (50%) + (25%) FYM+ (25%) VC	8.95 (3.07)	8.12 (2.93)	9.72 (3.20)	15.72 (23.35)	23.63 (29.09)
T ₉	RDF (50%) + (25%) FYM+ (25%) PM	8.82 (3.05)	9.43 (3.15)	9.54 (3.17)	16.94 (24.30)	25.51 (30.34)
T ₁₀	RDF (50%) + (25%) FYM + (25%) NOC	6.76 (2.69)	6.89 (2.71)	8.85 (3.06)	10.21 (18.59)	23.62 (29.08)
T ₁₁	25% FYM + (25%) VC + (25%) PM + (25%) NOC	7.58 (2.84)	7.82 (2.88)	8.84 (3.06)	10.56 (18.96)	21.41 (27.56)
T ₁₂	25 % FYM + (25%) VC + (25%) PM + (25%)NOC+ SWE(15kg/ha)	7.47 (2.82)	7.42 (2.81)	8.56 (3.01)	9.89 (18.33)	20.52 (26.94)
SEm (±)		0.05	0.07	0.06	0.45	0.77
CD (0.05)		0.14	0.21	0.19	1.33	2.26

* Figures in parentheses indicate the corresponding square root transformed values

** Figures in parentheses indicate the corresponding Angular transformed values

FYM - Farm yard manure, VC - Vermicompost, PM - poultry manure, NOC - Neem oil cake, SWE – Sea weed extract

Effect of INM on yield

In the present study fruit yield per ha. (10.49 ton) was found to be maximum with T₇ receiving 75% RDF + 25% neem oil cake which was at par with (T₅) 75 % RDF + 25% vermicompost which recorded yield (9.85 ton per ha).

Increase in yield might be due to combined application of inorganic fertilizers and organic fertilizers through neem oil cake proved to be very significant in reducing incidence of disease and pests. The efficacy of neem cake in reducing incidence of pest in okra was reported by Godase and Patel (2001) [6], Mallick and Lal, (1989) [15] and Tripathy *et al.*, (2009) [22]. Again application of neem oil cake along with chemical fertilizer significantly increased the number of fruits per plant, fruit weight which resulted in increasing yield. Application of neem cake increased N uptake by reducing urea hydrolysis, ammonia volatilization losses, leaching losses and decrease CO₂ evolution (Plant Horticulture Technology, 2002) [18]. Thus, neem cake application, as a whole might have increased allocation of photosynthates in the plant system, which might have resulted in higher number of fruits per plant and fruit weight in okra.

The present results corroborate with the findings of Kurup *et al.* (1997) [12]. The neem cake apart from improving the soil condition, also built up favourable C/N ratio with appreciably higher content of nutrients (Dahama, 2003) [4] and their ready

availability due to its slow release for a prolonged period could be possible reasons for influence on green fruit yield in okra. These findings corroborate with the findings of Prasad and Naik. (2013) [19], Mal *et al.* (2014) [14], Choudhary *et al.* (2015) [3], Das *et al.* (2014) [5], Anand *et al.* (2016) [2], Kumar *et al.* (2017) [11] and, Singh *et al.* (2018) in okra.

Effect of INM on economics of okra:

The total cost of cultivation in okra varied from Rs.46,302/- to Rs.87,552 ha⁻¹. Maximum cost of Rs.87,552 was incurred in T₁₂ where 25% N through FYM + 25% N through vermicompost + 25% N through poultry manure+25% N through neem oil cake + sea weed extract 15kg/ha were applied. Whereas, minimum cost of Rs. 46,302/ ha⁻¹ incurred in T₃ where RDF (75%) + *Azotobacter* + *Azospirillum* + PSB (2kg/ha.each) were applied. Highest gross income of Rs.1,45,770/ were obtained in treatment T₇ whereas lowest of Rs.93,576/ were obtained in T₃. Similarly highest net return of Rs.85,458/ were obtained in T₇ where 75 % RDF + 25 % neem oil cake were applied and was followed by T₅ (76,889/) where 75 % RDF + 25 % vermicompost were applied. Whereas, lowest of Rs.19,558/ were obtained in T₁₁ where only organic manures were applied. This might be due to that application of 75 % RDF + neem oil cake or vermicompost recorded significantly higher yield, which resulted in higher economic return. Highest B:C ratio (2.42) was observed in T₇ with integrated use of 75 % RDF + 25 % neem oil cake followed by T₅ (2.34) where 75 % RDF + 25 % vermicompost

were applied. The lowest B:C ratio of 1.22 was observed in T₁₁ where 25 % FYM + 25% vermicompost + 25% poultry manure + 25 % neem oil cake were applied. The increase in B:C ratio and other crop growth parameters might be due to

increase in yield which fetched more prices in market. These findings corroborate with the findings of Kumar *et al.* (2013), Mal *et al.* (2014)^[14] and Tyagi *et al.* (2016)^[23].

Table 2: Effect of INM on Economics of okra

	Treatments	Yield Per ha (ton)	Cost of cultivation (Rs)	Gross income (Rs)	Net Income (Rs)	B:C ratio
T ₁	100% RDF	8.72	46,446	1,01,902	55,456	2.19
T ₂	100% RDF + FYM (1.5 t / ha)	9.52	48,358	1,08,202	59,884	2.24
T ₃	RDF (75%) + <i>Azotobacter</i> + <i>Azospirillum</i> + PSB (2kg/ha.each)	8.27	46,302	93,576	47,274	2.02
T ₄	RDF (75%)+(25%)FYM	8.58	52,494	1,12,174	59,680	2.14
T ₅	RDF (75%)+(25%) VC	9.85	57,547	1,34,436	76,889	2.34
T ₆	RDF (75%)+(25%) PM	8.99	52,454	1,09,282	56,828	2.08
T ₇	RDF (75%) + (25%) NOC	10.49	60,312	1,45,770	85,458	2.42
T ₈	RDF (50%) + (25%) FYM+ (25%) VC	8.62	69,481	1,11,776	42,295	1.61
T ₉	RDF (50%) + (25%) FYM+ (25%) PM	8.35	58,865	1,01,326	42,461	1.72
T ₁₀	RDF (50%) + (25%) FYM + (25%) NOC	9.65	71,970	1,28,078	56,108	1.78
T ₁₁	25% FYM + (25%) VC + (25%) PM + (25%) NOC	7.30	86,950	1,06,508	19,558	1.22
T ₁₂	25 % FYM + (25%) VC + (25%) PM + (25%) NOC +SWE(15kg/ha)	7.49	87,552	1,09,154	21,602	1.25
	SEm (±)	0.31	-	-	-	-
	CD (0.05)	0.91	-	-	-	-

Conclusion

From the experimental result it was observed that integrated application of 75% RDF in the form of chemical fertilizers and 25 % through neem oil cake was found best in recording less incidence of insects, pests, diseases and produced higher yield and better economic return in okra.

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