E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(9): 536-539
Received: 02-06-2024
Accepted: 05-07-2024

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Effect of tillage, nutrient management and growth regulator on growth of green gram

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DOI: https://doi.org/10.33545/2618060X.2024.v7.i9Sh.1537

Abstract
A field trial was laid out in Instructional Farm, Department of Agronomy, College of Agriculture, Dapoli, Dist. Ratnagiri during *Rabi* and *Summer* seasons of 2021-22 and 2022-23. The experiment consists of 27 treatment combinations. The experiment consists of 27 treatment combinations. The main plot *i.e.*, horizontal strips consist of three tillage practices *viz*., T_1- Zero tillage (Placement of seed and fertilizer), T_2- Minimum tillage (opening of row and sowing of seeds) and T_3- Conventional tillage (all tillage operation and sowing of seeds). The sub plot *i.e.*, vertical strips consist of three fertilizer levels *viz*., F_1- 100% Recommended dose of fertilizer (RDF), F_2- 75% Recommended dose of fertilizer (RDF) and F_3- 50% Recommended dose of fertilizer (RDF). The split plot consists of three levels of plant growth regulator *viz*., G_1- Gibberellic acid (GA_3) 100 ppm, G_2- Gibberellic acid (GA_3) 200 ppm and G_3- Control (Water Spray). Results observed that treatment $T_3F_3G_2$ (Conventional tillage + 100% Recommended dose of fertilizer + GA_3 200 ppm) recorded maximum plant height and number of functional leaves plant^{-1} than other treatments of green gram during both the years of experimentation and in pooled data.

Keywords: Tillage, fertilizer levels, plant growth regulators, green gram, growth

Introduction
Green gram scientifically known as *Vigna radiata* is a plant species in the legume family and commonly called as mung bean, moong in India. Cereal-pulses is one of the important cropping systems practiced in India. The productivity of the system mainly depends on proper management practices. Major challenge in future for the researchers will be to develop an alternative cropping system that produce more at less cost with low water and energy and improve farm profitability and sustainability. Rising cost of fuel and availability of effective package of practices for conservation tillage are now redefining tillage in India in recent years. Integrating tillage practices with fertilizers and growth regulators was quite promising, in maintaining higher productivity. Appropriate tillage practices and nutrient management are some of the reasons behind the increasing economics or net returns of crop. Soil quality is determined by the efficient use of plant nutrients through judicially balanced and integrated use of all possible resources in conjunction with fertilizers application of recommended dose of NPK to sustain crop production. Therefore, the intervention on plant nutrition like nutrient management and recommended dose of fertilizer based on proper required hence we conducted study on "Effect of tillage, nutrient management and growth regulator on sweet corn green gram cropping sequence."

Materials and Methods
A field trial was laid out at Instructional Farm, Department of Agronomy, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri during *Rabi* and *Summer* seasons of 2021-22 and 2022-23. The experiment consists of 27 treatment combinations. The main plot *i.e.*, horizontal strips consist of three tillage practices *viz*., T_1- Zero tillage (Placement of seed and fertilizer), T_2- Minimum tillage (opening of row and sowing of seeds) and T_3- Conventional tillage (all tillage operation and sowing of seeds). The sub plot *i.e.*, vertical strips consist of three fertilizer levels *viz*., F_1- 100% Recommended dose of fertilizer (RDF), F_2- 75% Recommended

dose of fertilizer (RDF) and F_3- 50% Recommended dose of fertilizer (RDF). The split plot consists of three levels of plant growth regulator *viz*., G_1- Gibberellic acid (GA_3) 100 ppm, G_2- Gibberellic acid (GA_3) 200 ppm and G_3- Control (Water Spray). Statistical analysis of the data regarding the characters studied during investigation was carried out using the procedure appropriate to the Strip split plot design of experiment.

Results and Discussion

1. Plant height

Effect of tillage

The data given in the Table 1 indicates that, among the different types of tillage practices conventional tillage produced significantly superior taller plants at harvest stage of crop as compared to minimum tillage and significantly lower mean plant height at harvest stage of crop were recorded under zero tillage during the first and second year as well as in the pooled mean. This was due to better seed germination and crop establishment because of better land preparation and proper seed placement associated with this conventional tillage practice. Might be due to good soil condition, minimum weed competition, soil depth which friable for better growth of plant height. Similar result was reported by Suryavanshi *et al.* (2018) [10].

Effect of fertilizer levels

In fertilizer levels treatment 100% RDF recorded significantly superior plant height at harvest stage over the 75% RDF and 50% RDF recorded lowest plant height at harvest during both the year and in the pooled data. This might be due to supply of chemical fertilizer in adequate amount to the crop is crucial for the establishment and initial growth of plants in terms of plant height. Application of 100% RDF to the green gram increased availability of major nutrients to plant due to enhanced early root growth and cell multiplication leading to more absorption of other nutrients from deeper layers of soil ultimately resulting in increased plant growth attributes and finally increased crop growth rate**.**

Table 1: Growth parameters of green gram as influenced periodically by different treatments (2021-22 and 2022-23)

Treatment	Plant height (cm)			Number of functional leaves plant^{-1}		
	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
Vertical strips: Tillage practices						
T_1: Zero tillage	37.08	42.63	39.86	5.60	6.44	6.02
T_2: Minimum tillage	41.25	47.40	44.33	7.03	8.02	7.52
T_3: Conventional tillage	44.97	51.57	48.27	8.55	9.78	9.16
S.Em.±	0.19	0.28	0.23	0.03	0.16	0.09
C.D. at 5%	0.75	1.09	0.91	0.12	0.64	0.33
Horizontal strips: Fertilizer levels						
F_1: 100% RDF	43.45	49.55	46.50	8.42	9.44	8.93
F_2: 75% RDF	41.99	48.09	45.04	7.66	8.68	8.17
F_3: 50% RDF	37.87	43.97	40.92	5.10	6.12	5.61
S.Em.±	0.09	0.22	0.13	0.02	0.10	0.04
C.D. at 5%	0.37	0.87	0.50	0.09	0.39	0.16
Split plot: Plant growth regulators						
G_1: GA_3 100 ppm	41.21	47.31	44.26	8.04	9.06	8.55
G_2: GA_3 200 ppm	42.72	48.82	45.77	6.98	8.00	7.49
G_3: Water spray	39.37	45.47	42.42	6.16	7.18	6.67
S.Em.±	0.08	0.10	0.09	0.06	0.09	0.07
C.D. at 5%	0.24	0.29	0.25	0.16	0.25	0.19
Interaction						
Tillage× Fertilizer Levels						
S.Em.±	0.08	0.21	0.12	0.04	0.20	0.09
C.D. at 5%	0.25	N.S.	N.S.	0.13	N.S.	N.S.
Tillage × Plant Growth Regulators						
S.Em.±	0.14	0.17	0.15	0.10	0.15	0.12
C.D. at 5%	0.41	0.50	0.43	N.S.	N.S.	N.S.
Fertilizer Levels × Plant Growth Regulator						
S.Em.±	0.14	0.17	0.15	0.10	0.15	0.12
C.D. at 5%	0.41	N.S.	0.43	N.S.	N.S.	N.S.
Tillage × Fertilizer Levels × Plant Growth Regulator						
S.Em.±	0.25	0.30	0.26	0.17	0.27	0.20
C.D. at 5%	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
General mean	41.10	47.20	44.15	7.06	8.08	7.57

Effect of growth regulator

Among different concentration growth regulator Gibberellic acid The 200 ppm significantly superior plant height at harvest stage compared to Gibberellic acid 100 ppm and lowest mean plant height were recorded during both the year and in the pooled data in case of Control (Water spray). This may be attributed to the capacity of GA_3 to induce mRNA synthesis pertaining to hydrolytic enzymes and to the increased cell enlargement eventually leading to increased length of internodes. These results are in accordance with those reported Abdel *et al.* (2011) [1]. Baliah *et al.* (2018) [3] reported that this may be attributed to the capacity of GA_3 to induce mRNA synthesis pertaining to hydrolytic enzymes and to the increased cell enlargement eventually leading to increased length of internodes, this finding similar with Sharma *et al.* (2020) [9].

Interaction effect (Tillage and fertilizer levels)

The data presented in the Table 1.1 revealed that, treatment combination conventional tillage with 100% RDF (T_3F_1) recorded significantly maximum plant height at harvest over rest of treatments during first year. On the other hand, treatment combination zero tillage with 50% RDF (T_1F_3) recorded minimum plant height at harvest during first year, second year and in the pooled data.

Interaction effect (Tillage and growth regulator)

Data presented in Table 1.1 revealed that, treatment combination conventional tillage with Gibberellic acid (T_3G_2) 200 ppm recorded significantly more plant height at harvest stage over rest of treatments during first year, second year and in pooled data. On the other hand, treatment combination zero tillage with control (T_1G_3) recorded lowest plant height at harvest stage during first year, second year and in the pooled data.

Interaction effect (fertilizer levels and growth regulator)

The interaction of fertilizer levels 100% RDF along with growth regulator Gibberellic acid 200 ppm (F_1G_2) recorded significantly higher mean plant height over rest of the treatment combinations at harvest stage during both the year and in the pooled data. On the other hand, 50% RDF along with water spray (F_3G_3) recorded lowest mean plant height at harvest stage during first year, second year and in pooled data.

2. Number of functional leaves per plant

Effect of tillage

Functional leaves plant^{-1} was significantly influenced at harvest during first year, second year and in the pooled mean by different tillage treatments under study. Among the different types of tillage practices conventional tillage produced significantly a greater number of leaves than to minimum tillage and lowest mean number of leaves were recorded zero tillage at harvest stage during first year, second year and in the pooled mean. Functional leaves plant^{-1} was significantly influenced at 40 DAS, 60 DAS and at harvest during first year, second year and in the pooled mean by different tillage treatments under study. This might be due to the suitable soil environment created due to tillage and residue management caused more retention of moisture and uptake nutrients which help in enhancing crop growth ultimately increases number of functional leaves per plant. These results are in accordance with Tomer *et al.* (2021) [11]. Patel *et al.* (2022) [7] reported that friable soil condition, soil water absorption ratio, low weed density and soil aeration increases number of functional leaves per plant and more chlorophyll intensity as compared to zero tillage.

Interaction effect between tillage and fertilizer levels, tillage and plant growth regulator and fertilizer levels and plant growth regulator on plant height at harvest of green gram (2021-22, 2022-23 and in pooled data)

Plant height (cm)			
Tillage \ Fertilizer level	2021-22		
	F_1: 100% RDF	F_2: 75% RDF	F_3: 50% RDF
T_1: Zero tillage	39.19	38.00	34.07
T_2: Minimum tillage	43.61	42.12	38.04
T_3: Conventional tillage	47.55	45.87	41.49
SE. m. (±)	0.08		
C.D. at 5%	0.25		

Plant height (cm)									
Tillage \ Plant growth regulators	2021-22			2022-23			Pooled		
	G_1: GA_3 100 ppm	G_2: GA_3 200 ppm	G_3: Water spray	G_1: GA_3 100 ppm	G_2: GA_3 200 ppm	G_3: Water spray	G_1: GA_3 100 ppm	G_2: GA_3 200 ppm	G_3: Water spray
T_1: Zero tillage	37.03	38.23	36.00	42.58	43.78	41.55	39.80	41.01	38.77
T_2: Minimum tillage	41.41	42.87	39.48	47.56	49.02	45.63	44.49	45.94	42.56
T_3: Conventional tillage	45.20	47.07	42.63	51.80	53.67	49.23	48.50	50.37	45.93
SE. m. (±)	0.14			0.17			0.15		
C.D. at 5%	0.41			0.50			0.43		

Plant height (cm)						
Fertilizer levels \ Plant growth regulator	2021-22			Pooled		
	G_1: GA_3 100 ppm	G_2: GA_3 200 ppm	G_3: Water spray	G_1: GA_3 100 ppm	G_2: GA_3 200 ppm	G_3: Water spray
F_1: 100% RDF	43.70	45.26	41.39	46.75	48.31	44.44
F_2: 75% RDF	42.00	43.64	40.34	45.05	46.69	43.39
F_3: 50% RDF	39.42	40.81	37.75	42.47	43.86	40.80
SE. m. (±)	0.14			0.15		
C.D. at 5%	0.41			0.43		

Effect of fertilizer levels

In fertilizer levels treatment 100% RDF recorded significantly superior functional leaves plant^{-1} at harvest stage over the 75% RDF and 50% RDF recorded lowest functional leaves plant^{-1} at harvest stage during the first year, second year and in the pooled data. Nettikantaiah *et al.* (2008) [6] reported that the increase in number of leaves is attributed to the increased root and shoot growth in early phase which resulted in a greater number of leaves. N, P and K are major plant nutrients causing increased meristematic activity of the plant as a result of proportionate increase in growth attributes in terms of number of leaves plant^{-1}. These results are in conformity with those reported by Kalsaria *et al.* (2017) [5].

Effect of growth regulator

Among plant different concentration growth regulator in case of functional leaves plant^{-1} treatment Gibberellic acid at the rate 200 ppm significantly superior functional leaves plant^{-1} at harvest stage as compared to Gibberellic acid with concentration of 100 ppm and Control (G_3) were recorded lowest functional leaves plant^{-1} at harvest stage during the first year, second year in the pooled data. Increase of chlorophyll content by foliar application of GA_3 and act as stimulant for chlorophyll synthesis. These results are in conformity with the research findings of Rahim *et al.* (2018) [8].

Conclusion

From the two years of experimentation, it can be concluded that, the treatment $T_3F_3G_2$ Conventional tillage + 100% Recommended dose of fertilizer + GA_3 200 ppm showed higher growth parameters such as plant height, number of functional leaves plant^{-1} of green gram.

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