Plant Archives Vol. 24, No. 2, 2024 pp. 1625-1630 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.2.230

INFLUENCE OF TILLAGE, NUTRIENT MANAGEMENT AND GROWTH REGULATOR ON QUALITY OF SWEET CORN

S.S. Kinge[1], S.B Bhagat[2], P.S. Bodake[1], V.G. Chavan[1], V.G. Salvi[3], R.L. Kunkerkar[4], T.N. Thorat[1], V.A. Rajemahadik[1] and Y.S. Chavan[1]

[1]Department of Agronomy, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India.
[2]AICRP on Integrated Farming System, Regional Agriculture Research Station, Karjat, Maharashtra, India.
[3]Department of Soil Science and Agricultural Chemistry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India.
[4]Department of Agricultural Botany, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India.
*Corresponding author E-mail : sunilkinge40@gmail.com
(Date of Receiving-03-07-2024; Date of Acceptance-08-09-2024)

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 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 $T_3F_3G_2$ (Convectional tillage + 100 % Recommended dose of fertilizer + GA_3 200 ppm) accumulated the higher quantity of quality parameter such as protein content (%), total soluble solids (°Brix) and total sugar (%) in sweet corn than other treatments during both years of experimentation and in pooled data.

Key words : Tillage, Fertilizer levels, Plant growth regulators, Sweet corn.

Introduction

Maize (*Zea mays* L.) is an important cereal crop for food, feed and fodder. It is not only an important food crop for human but also a basic element of animal feed, fodder and raw material for manufacturing of many industrial products. Sweet corn (*Zea mays* var. *saccharata*) also known as sugar corn is a variety of maize with high sugar content. 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 in sweet corn-green gram cropping sequence."

Materials and Methods

A field trial was laid out in Plot No. 43 at Instructional Farm, Department of Agronomy, College of Agriculture, Dapoli, Dist. Ratnagiri during *kharif* and *rabi* seasons of 2021-22 and 2022-23 with crops *viz.*, sweet corn and green gram as test crops. The selected site is located at 17°45'57" N latitude and 73°10'29" E longitude, with an elevation of around 157.8 m. The area falls under 19.2 Agro-ecological sub-region (AESR) *i.e.*, Central and Sahyadri region represented by hot moist sub-humid to humid transitional ecological sub-region (ESR) with deep loamy to clay red and lateritic soils, low to medium available water capacity (AWC) and length. The experimental plot had well drained soil. The soil analysis indicated that the soil of experimental plot was sandy clay loam in texture, medium in available nitrogen (210.23 kg ha^{-1}) and potassium content (275.11 kg ha^{-1}), low in phosphorus (9.34 kg ha^{-1}) and very high in organic carbon content (11.31 g kg^{-1}) and acidic in reaction (pH 5.57). 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). The field experiment was conducted in lateritic soils (Alfisols). Sweet corn hybrid Sugar-75 was used in the trial. Sowing of the sweet corn was done at 60 cm × 20 cm spacing during the *Rabi* season of 2021-22 and 2022-23, respectively. Statistical analysis of the data regarding the characters studied during the course of investigation was carried out using the procedure appropriate to the Strip split plot design of experiment.

Quality studies

Sugar (reducing, non-reducing and total sugar) content, protein content and total soluble solids (TSS) in the kernels of sweet corn from the individual treatment were determined as the quality parameters of sweet corn.

Protein content in kernels (%)

The individual treatment wise kernel sample was subjected to nitrogen content analysis by modified micro Kjeldahl method (Piper, 1956). Then the protein content was calculated by multiplying the nitrogen content (%) in the kernel by the factor 6.25

Sugar content (%)

The reducing, non-reducing and total sugar were determined from freshly harvested kernel samples from each treatment.

Reducing sugar (%) : Reducing sugar per cent was determined by Lane and Eynon method with modifications suggested by Ranganna (1997), which is based on the principle that the reducing sugar (*i.e.*, glucose in sweet corn) when heated with copper tartrate, reduce the copper from the cupric to cuprous state and thus cuprous oxide is formed. Treatment wise fresh kernels samples were separated from green cobs were crushed into a mortar by pestle and juice was extracted from the kernels. About 25 g sample was taken and sugar content (%) was estimated by using following formula

$$\text{Reducing sugar \%} = \frac{\text{Glucose value of Fehling's solution} \times (250/50) \times (100/50)}{\text{Burette reading}}$$

Non-reducing sugar (%) : The non-reducing sugar per cent was recorded in respect of each treatment by using following formula:

Non-reducing Sugar = % reducing sugar × 0.95

Total sugar (%) : The sum of reducing and non-reducing sugar gives the total sugar (%) in case of each treatment.

T.S.S. (°Brix)

The individual treatment wise kernel samples were subjected to total soluble solids (TSS) content which is determined with the help of hand refractometer.

Results and Discussion

Protein content (%), Total soluble solids (TSS) content (°Brix) and Total sugar (%) of sweet corn were considered as the quality parameters. Data pertaining protein content, TSS content and Total sugar of sweet corn as influenced by the different treatments are presented in Tables 1 and 2.

Protein content (%)

Data presented in the Table 1 revealed that protein content (%) in sweet corn influenced significantly by the various treatments.

Table 1 : Protein content (%) of sweet corn as influenced by different treatments (2021-22 and 2022-23).

Treatment	Protein content (%)		
	2021-22	2022-23	Pooled
Vertical strips: Tillage practices			
T_1: Zero tillage	12.42	11.99	12.21
T_2: Minimum tillage	14.76	15.19	14.97
T_3: Conventional tillage	16.61	16.66	16.63
S.Em. ±	0.26	0.22	0.23
C.D. at 5 %	1.02	0.86	0.89
Horizontal strips: Fertilizer levels			
F_1: 100 % RDF	16.42	16.39	16.41
F_2: 75 % RDF	14.48	14.67	14.58
F_3: 50 % RDF	12.90	12.77	12.83
S.Em. ±	0.25	0.31	0.20
C.D. at 5 %	0.98	1.23	0.79
Split plot: Plant growth regulators			
G_1: GA_3 100 ppm	14.52	14.61	14.57
G_2: GA_3 200 ppm	15.83	15.95	15.89
G_3: Water spray	13.45	13.27	13.36
S.Em. ±	0.33	0.41	0.35
C.D. at 5 %	0.93	1.19	1.01
Interaction			
Tillage × Fertilizer Levels			
S.Em. ±	0.28	0.88	0.56
C.D. at 5 %	N.S.	N.S.	N.S.
Tillage × Plant Growth Regulators			
S.Em. ±	0.56	0.72	0.61
C.D. at 5 %	N.S.	N.S.	N.S.
Fertilizer Levels × Plant Growth Regulators			
S.Em. ±	0.56	0.72	0.61
C.D. at 5 %	N.S.	N.S.	N.S.
Tillage × Fertilizer Levels × Plant Growth Regulators			
S.Em. ±	0.98	1.24	1.06
C.D. at 5 %	N.S.	N.S.	N.S.
General Mean	**14.60**	**14.61**	**14.60**

Effect of tillage

The data showed in Table 1 indicated that, during the both the year of experimentation and in the pooled data, among the different tillage practices convectional tillage showed significantly superior protein content than minimum tillage and lowest protein content were recorded in zero tillage during first and second year as well as in the pooled data. Tillage increases rates of mineralization and a higher potential for nitrification will lead to an increase in available N and enhances plant uptake availability. It is possibly because convectional tillage broke the compacted layer, allowing better nitrogen and water uptake from deeper soil layers due moisture and nutrient availability These results are similar with those reported by Brezinscak *et al*. (2022) and Ansari *et al*. (2023).

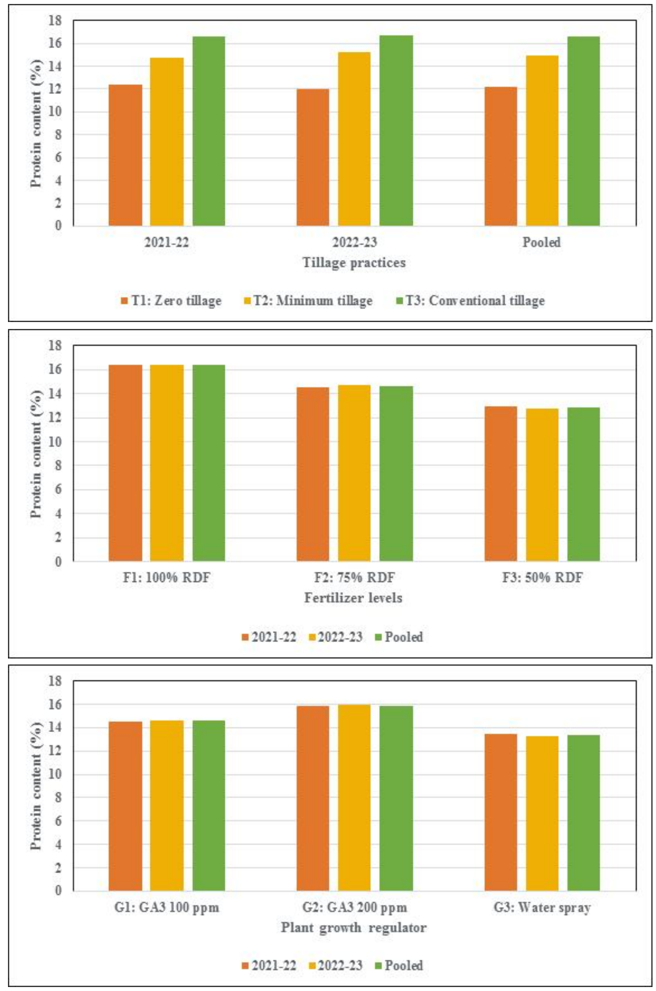

Fig. 1 : Protein content (%) of sweet corn as influenced by the different tillage practices, fertilizer levels and growth regulator treatments during 2021-2022, 2022-2023 and in the pooled mean.

Effect of fertilizer levels

Among the fertilizer levels treatment 100% RDF significantly superior protein content than 75 and 50% RDF were recorded lowest protein content during both the years and in the pooled data. Higher levels of N nutrients increase the uptake of nitrogen by plant which is a principal constituent of protein molecules. Higher nitrogen uptake would have resulted in higher amino acid, protein, starch and phenol content in sweet corn kernel. Waghmode *et al*. (2015) reported that role of N helps an important role in synthesis of nucleic acid and protein. Hence, it can reflect into higher protein content of maize.

Effect of growth regulator

The data presented in Table 1 revealed that, protein content significantly influenced due to the growth

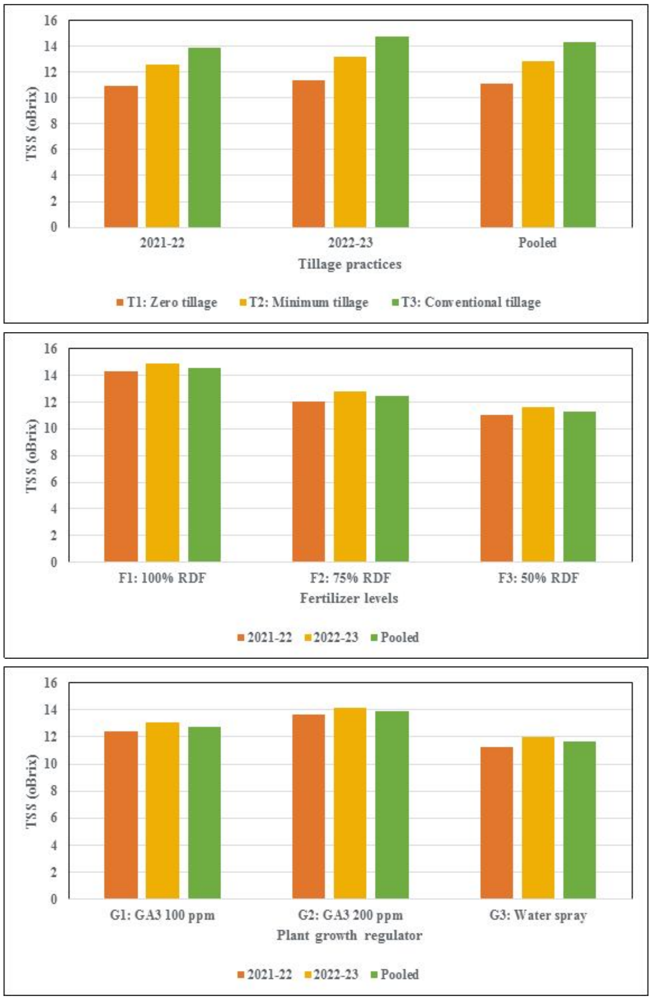

Fig. 2 : TSS (°Brix) of sweet corn as influenced by the different tillage practices, fertilizer levels and growth regulator treatments during 2021-2022, 2022-2023 and in the pooled mean.

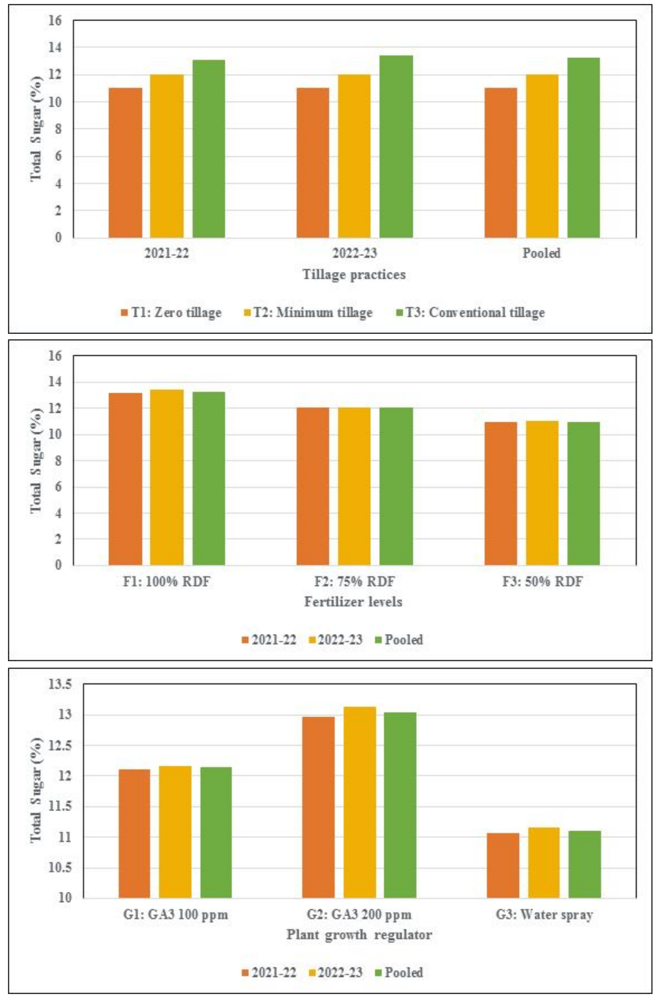

Fig. 3 : Total Sugar (%) of sweet corn as influenced by the different tillage practices, fertilizer levels and growth regulator treatments during 2021-2022, 2022-2023 and in the pooled mean.

regulator during both the year and in the pooled data. The treatment Gibberellic acid 200 ppm significantly superior protein content as compared to Gibberellic acid 100 ppm and Control were recorded lowest protein content during both the years and in the pooled data. These results are consistent with previous reports which demonstrated that the application of GA_3 increased the protein content in maize. The supply of GA_3 plays an essential role in protein biosynthesis because it can increase the uptake of N from the soil. Similar finding closely related with Mohammed *et al.* (2007).

Interaction effect

It is observed from the data depicted in Table 1 that the interaction effect between various treatments *i.e.* tillage and fertilizer levels, tillage and growth regulator, fertilizer levels and growth regulator were found to be non-significant with respect to protein content of sweet corn.

Total soluble solids (°Brix) and Total sugar (%)

Data presented in the Table 2 revealed that total soluble solids (°Brix) and total sugar (%) in sweet corn influenced significantly by the various treatments.

Effect of tillage

The data showed in Table 2 indicated that, among the different tillage practices convectional tillage showed significantly higher in total soluble solids (TSS) and total sugar per cent than minimum tillage and in zero tillage during both year and in the pooled data. These results are similar with those reported by Simic *et al.* (2020) and Brezinscak *et al.* (2022).

Effect of fertilizer levels

Among the fertilizer levels treatment 100% RDF significantly superior total soluble solids (TSS) content and total sugar per cent than 75% RDF and 50% RDF were recorded lowest total soluble solids (TSS) and total

Table 2 : Total soluble solids (°Brix) and Total sugar (%) of sweet corn as influenced by different treatments (2021-22 and 2022-23).

Treatment	TSS (°Brix)			Total Sugar (%)		
	2021-22	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**
Vertical strips: Tillage practices						
T_1: Zero tillage	10.90	11.35	11.12	11.03	11.04	11.03
T_2: Minimum tillage	12.56	13.17	12.86	12.02	12.01	12.01
T_3: Conventional tillage	13.93	14.74	14.33	13.09	13.41	13.25
S.Em. ±	0.33	0.29	0.31	0.22	0.18	0.20
C.D. at 5 %	1.30	1.15	1.22	0.86	0.71	0.78
Horizontal strips: Fertilizer levels						
F_1: 100 % RDF	14.29	14.86	14.58	13.14	13.38	13.26
F_2: 75 % RDF	12.05	12.78	12.42	12.05	12.09	12.07
F_3: 50 % RDF	11.04	11.61	11.32	10.94	10.99	10.96
S.Em. ±	0.16	0.20	0.18	0.21	0.13	0.17
C.D. at 5%	0.63	0.78	0.69	0.82	0.51	0.66
Split plot: Plant growth regulators						
G_1: GA_3 100 ppm	12.45	13.06	12.76	12.10	12.17	12.14
G_2: GA_3 200 ppm	13.68	14.16	13.92	12.97	13.12	13.04
G_3: Water spray	11.25	12.03	11.64	11.06	11.16	11.11
S.Em. ±	0.33	0.34	0.32	0.29	0.30	0.29
C.D. at 5 %	0.94	0.97	0.92	0.83	0.86	0.83
Interaction						
Tillage× Fertilizer Levels						
S.Em. ±	0.36	0.41	0.38	0.20	0.24	0.22
C.D. at 5 %	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Tillage × Plant Growth Regulators						
S.Em. ±	0.57	0.59	0.56	0.50	0.52	0.50
C.D. at 5 %	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Fertilizer Levels × Plant Growth Regulators						
S.Em. ±	0.57	0.59	0.56	0.50	0.52	0.50
C.D. at 5 %	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Tillage × Fertilizer Levels × Plant Growth Regulators						
S.Em. ±	0.98	1.02	0.96	0.87	0.90	0.87
C.D. at 5 %	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
General Mean	**12.46**	**13.08**	**12.77**	**12.04**	**12.15**	**12.10**

sugar per cent during both the years and in the pooled data. Might be due to increased availability of N, P, K in RDF actively encourage the reducing and non-reducing sugars also total soluble solids. These findings are close confirmation with Waghmode *et al*. (2015) and Bharathi *et al*. (2020).

Effect of growth regulator

The data presented in Table 2 revealed that, protein content significantly influenced by the growth regulator during both the years and in the pooled data. In total soluble solids (TSS) and total sugar in the treatment gibberellic acid 200 ppm significantly superior compared to gibberellic acid 100 ppm and Control were recorded lowest total soluble solids (TSS) content and total sugar per cent during the first and second year and in the pooled data. This finding might be due to applying suitable PGRs during the dry season, the TSS of sweet corn was proportionally increased. Statistical analysis found that PGRs in form gibberellic acid significantly increases total soluble solids content than control under drought stress conditions during the dry season and diverted photo assimilate into sink organs during the vegetative stage, affecting the accumulation of carbohydrates and sugar. Similar results were found by Mubarok *et al*. (2022).

Interaction effect

It is seen from the data depicted in Table 2 that the interaction effect between various treatments *i.e.* tillage and fertilizer levels, tillage and growth regulator, fertilizer levels and growth regulator was found to be non-significant with respect to total soluble solids content and total sugar percent of sweet corn.

Conclusion

From the two years of experimentation, it can be concluded that, the treatment $T_3F_3G_2$ *i.e.* Convectional tillage + 100% Recommended dose of fertilizer + GA_3 200 ppm positively influenced on protein content %, total soluble solids (^{o}Brix) and total sugar (%) of sweet corn.

References

Ansari, M.A., Ravisankar N., Ansari M.H., Babu S., Layek J. and Panwar A.S. (2023). Integrating conservation agriculture with intensive crop diversification in the maize-based organic system: Impact on sustaining food and nutritional security. *Front. Nutr.*, **10**, 1137247.

Bharathi, A., Balusamy M., Somasundaram E. and Shanmugasundaram R. (2020). INM on sweet corn kernel quality of sweet corn. *J. Pharmacog. Phytochem.*, **9(6S)**, 01-04.

Brezinscak, L., Kontek M., Bogunovic I. and Horvat D. (2022). Impact of Conservation Tillage on Grain Yield and Yield Components of Maize in North-West Croatia. *Agriculturae Conspectus Scientificus*, **87(2)**, 103-109.

Mohammed, A. (2007). Physiological aspects of mungbean plant (*Vigna radiata* L.) in response to salt stress and gibberellic acid treatment. *Res. J. Agricult. Biolog. Sci.*, **3**, 200–213.

Mubarok, S., Wicaksono F.Y., Nuraini A., Rahmat B.P.N. and Budiarto R. (2022). Agronomical characteristics of sweet corn under different plant growth regulators during the dry season. *Biodiversitas J. Biolog. Diversity*, **23(6)**.

Piper, C.S. (1956). *Soil and Plant Analysis*. Indian education Hans Publication Bombay. pp. 19-136.

Ranganna, S. (1997). *Hand book of analysis and quality control for fruits and vegetables products*. 2nd Edn. Tata McGrew Hill Publishing Company, Ltd. New Delhi. pp. 12-19.

Simic, M., Dragicevic V., Mladenovc Drinic S., Vukadinovic J., Kresoviæ B., Tabakovic M. and Brankov M. (2020). The contribution of soil tillage and nitrogen rate to the quality of maize grain. *Agronomy*, **10(7)**, 976.

Waghmode, B.R., Sonawane S.V. and Tajane D.S. (2015). Differential responses of yield and quality to organic manures in sweet corn [*Zea mays* (L.) *saccharata*]. *Int. J. Agricult. Sci.*, **11(2)**, 229-237.