Bio-Science Research Bulletin
http://www.bpasjournals.com

Original Research Article

Print version ISSN 0970 0889
Online version ISSN 2320 3161
DOI: 10.5958/2320-3161.2021.00002.X
Vol. 37 No. 1, January-June 2021: P.4-11

Effect of Molasses on the Growth of Okra, *Abelmoschus esculentus* (L.) Moench (Dicotyledonae: Malvaceae)

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Received on 13.01.2021
Accepted on 25.05.2021

ABSTRACT

Vegetables are important for health due to their contents as minerals, antioxidant, vitamins, phytochemicals and dietary fiber. All these substances are related to lower the risks for development of health problems. The use of chemical fertilizers affected both soil health and crop productivity in the long term. An experiment was conducted for the assessment of molasses effect on okra (ladies' finger) under natural environment at the Botanical Garden of Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (Haryana). During investigation all the attributes for growth stages of plants as per molasses treatment and control groups were observed. The treatment of molasses concentrations *viz.* 5%, 3% and 1% to response of plant growth was recorded after standard post sowing interval and compared with the control group as well. The present work revealed the better plant growth and yields of okra in soil blended with molasses as organic fertilizer than the field without molasses. Therefore, authors wish to recommend the molasses as profound organic fertilizer for eco-friendly farming and sustainable agriculture.

KEYWORDS: Vegetables, Okra, Ladies' finger, *Abelmoschus esculentus,* Molasses, Organic fertilizer, Plant growth, Sustainable agriculture.

INTRODUCTION

Ladies' finger, *Abelmoschus esculentus* (L.) Moench is the most common vegetable crop of India and valued for its edible green seed pods in regular diet. It is the member of family Malvaceae and an annual herb more commonly known by several vernacular names as okra, bhindi, or gumbo (Carney & Richard, 2009; Dhaliwal, 2010; Kumar et al., 2013).

Generally, okra is a high-value crop because it represents a source of nutrients that are important to human health, e.g., vitamins, potassium, calcium, carbohydrates, dietary fiber, and unsaturated fatty acids such as linolenic and oleic acids, and also of bioactive chemicals (Moyin-Jesu, 2007; Habtamu et al., 2014; Das et al., 2019; Aggarwal et al., 2020; Devi et al., 2020; Sehrawat et al., 2020).

Okra is a multipurpose crop due to the varied use of its leaves, buds, flowers, pods, stems, and seeds as well (Mihretu et al., 2014; Singh et al., 2019; Singh et al., 2020a; Singh et al., 2020b).

Previously, the extract from seeds of lady finger was demonstrated to contain polyphenols, tannin, flavonoids, terpenoids, saponins, long chain fatty acids, and glutathione (Manee and Kaewsrichan, 2017).

Okra has long been used as a regular vegetable and a source of dietary medicine to cure several serious diseases (Maganha et al., 2010; Benchasr, 2012; Messing et al., 2014; Roy

et al., 2014 Aggarwal et al., 2021; Doharey et al., 2021).

Indeed, beside its nutritional role, it is suitable for certain medical and industrial applications (Benchasr, 2012; Chowdhury et al., 2019).

Potential beneficial effects associated to okra and their components are cardioprotective, antidiabetic, renal protective, neuroprotective, anticancer, analgesic, antiulcer, antibacterial, and antifatigue (Vayssade et al., 2010; Hossen et al., 2013; Monte et al., 2014; Shammi et al., 2014; Xia et al., 2015; Mairuae et al., 2015; Solomon et al., 2016; Vindika et al., 2018; Durazzo et al, 2019; Ware, 2019; Singh et al., 2020c; Yadav et al., 2020; Yadav et al., 2021**).**

The industrialization and urbanization created enormous problems to environment by producing a large quantity of wastes which may leads to several health hazards in the society (Upadhyay, 2019; Pandey et al., 2020). The disposal of industrial and domestic waste is becoming a problem of environmental and health concern (Singh et al. 2020d, Kumar et al., 2021).

These wastes were discharging directly to nearby land and river (Khan, 2006). Molasses is one of the important byproducts of sugar industries (Olbrich, 1963).

Molasses produced annually in large quantities and used in various industries for production of animal feed, alcohol and fertilizers. The use of sugar beet molasses in agriculture stimulates nutrient elements uptake efficiency and soil biological activity (Samavat and Samavat, 2014; Singh et al., 2020e).

Molasses has been used in the past as fertilizer and soil improver particularly on sandy soil and soil of poor structure (Barnes, 1954; Singh et al., 2021a; Singh et al., 2021b).

The physicochemical analysis of diluted molasses showed that it is slightly acidic and contains a fairly good amount of calcium, magnesium and other essential nutrients like sodium potassium, chlorides, carbonates, bicarbonates and sulphates (Thakare et al., 2013).

Filter mud cake (FMC), Farm yard manure (FYM) and molasses increased NPK (N, Nitrogen; P, Phosphorus; K, Potassium) uptake and yields (Vitosh, 1996; Abo-Baker, 2017).

Molasses improves soil aggregation and reduces surface crusting in hard-setting soils (Wynne and Meyer, 2002). Molasses sterilize soil partially and increase nitrogen fixation (Rouillard, 1954).

As the chemical fertilizer reduces soil fertility in long term and leads enormous threat to agro-ecology (Zhang et al., 2018). Hence, molasses as organic fertilizer could be substitute to it for better growth and production of crops (Pyakurel et al., 2019).

Therefore the present investigation is undertaken to study the effect of molasses on the growth of okra for eco-friendly farming and sustainable agriculture.

MATERIALS AND METHODS

The seeds of okra (*Abelmoschus esculentus* (L.) Moench) were procured from the Numberdar Trading Company, New Grain Market, Shahabad- Markanda, Ambala (HR), India. The seeds were maintained in the Botany Laboratory, Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (HR), India. Four soil pots were prepared in the Botanical garden blended with different percentages of molasses (w/w) *viz.* 5%, 3%, 1% and 0% (control) after Thakare et al. (2013). Two seeds were sown in each pot. All sets were irrigated equally with water at same interval. The growth attributes *viz.* number of seeds germinated, shoot height, number of leaves and number of fruits on each plant were recorded after the given time interval.

RESULTS

The okra (*Abelmoschus esculentus* (L.) Moench) seeds were sown in the experimental and control soil pots of Botanical garden on 25th February, 2020. All the growth attributes (number of seed germinated, height of plants, number of leaves in each plant and number of fruits) in experimental and control groups were periodically assessed and recorded

(Table 1). The maximum plant growth 13cm (Total height 35cm) was recorded in soil pot with 5% molasses followed by 10cm (Total height 30.5cm) in soil pot with 1% molasses (Figure 1). The soil pot without blending of molasses (controlled group) showed even equal rate of germination but the growth rate was minimum with 5cm height only (Total height 14cm). The maximum number of leaves 10 were observed in P_1 (5% molasses) and minimum number of leaves 3 in P_3 soil pot with 1% molasses (Figure 2). The fruits were observed maximum 15 in P_1 (5% molasses) followed 10, 8, and 6 fruits or green seed pods in P_4 (0% molasses), P_2 (3% molasses) and P_3 (1% molasses) respectively (Figure 2).

Table 1: Growth attributes (*Abelmoschus esculentus* (L.) Moench) in experimental groups (with molasses) and controlled group (without molasses) at different interval.

Parameters	**Experimental group (5% molasses) P_1**				**Experimental group (3% molasses) P_2**				**Experimental group (1% molasses) P_3**				**Controlled group (0% molasses) P_4**			
Time interval	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Shoot growth (cm)	4	6	12	13	3.5	4	6	7	6.5	6	8	10	2	3	4	5
Total number of leaves	2	4	6	10	2	3	4	4	2	1	3	3	2	2	3	4
Total number of fruits	-	-	8	15	-	-	4	8	-	-	2	6	-	-	1	10

Where: I, 5th March 2020; II, 23rd March 2020; III, 30th March, 2020; IV, 7th April 2020.

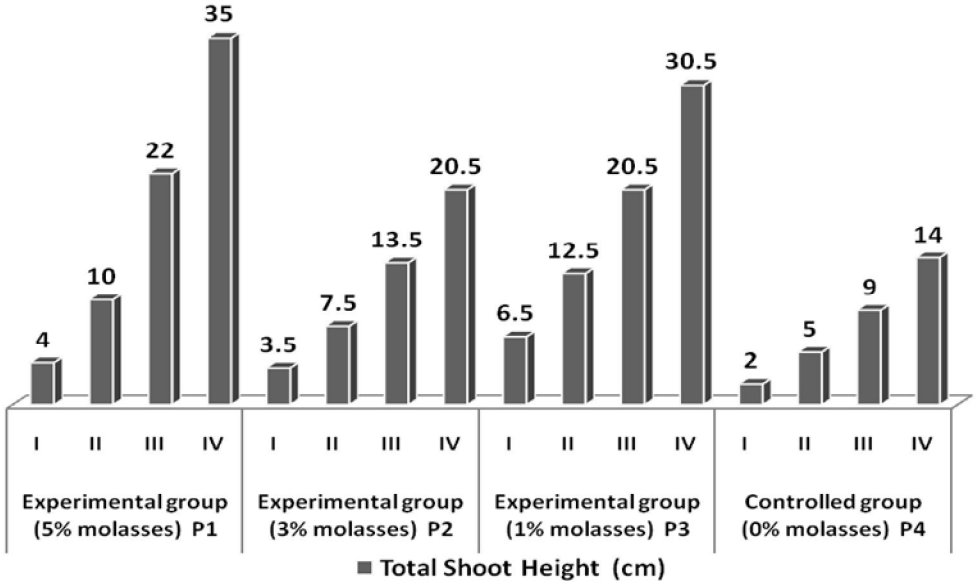

Figure 1: Total height of okra plant in experimental and controlled groups at different interval. *Where: I, 5th March 2020; II, 23rd March 2020; III, 30th March, 2020; IV, 7th April 2020.*

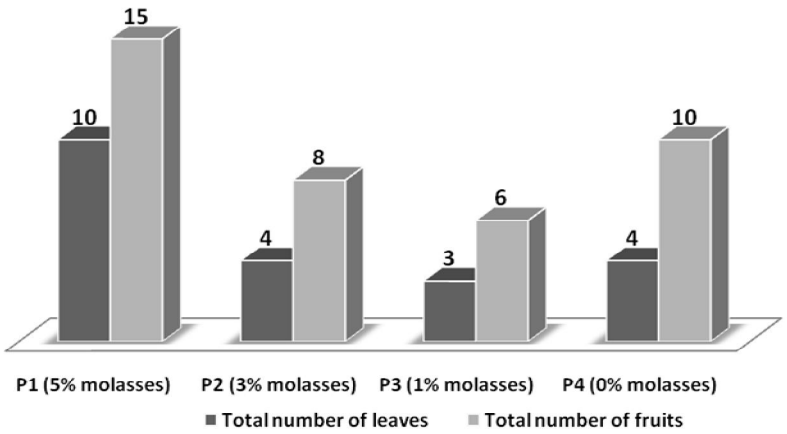

Figure 2: Total number of leaves and fruits of okra in experimental and controlled groups on 7th April, 2020.

DISCUSSION

During the investigation it has been revealed that molasses concentrations 5% and 3% were favorable for significant growth of okra plant, number of leaves and fruits. These findings were in conformity with the observations recorded by Somashekar et al. (1984) in jowar, bajra and rice. At these blending concentrations the ladies' finger plants were efficiently able to absorb maximum nutrients both from soil and diluted molasses resulted augmented yields. This indicates that, the ingredients present in the blends of diluted molasses and soil at particular concentration were supportive to the growth and production of plants. It was recorded that 0.2 to 1% effluent-soil blending concentration has given positive results in the yield of ladies' finger (Thakare et al., 2013).

Nennah and Kebbia (1983) also noted increased yield of sugarcane to about 20% when diluted effluent of an integrated pulp-paper mill used in open sugarcane cropped field irrigation. The molasses as organic fertilizer supplied carbohydrates and alters C:N ratio (carbon : nitrogen ratio) which affects soil microbial ecology and lowers plant parasitic nematodes as well as provided other favorable environment for better plant growth (Schenck, 2001).

Dhar (1934) reported that, due to oxidation of carbohydrates (60-70% molasses) organic acids were formed which dissolves the native calcium carbonate and helped in reclamation of alkali soils. Molasses also increases the growth of shoot length, leaf number per plant, leaf area and chlorophyll content of peas (Rani and Srivastava, 1990).

CONCLUSIONS

Okra (*Abelmoschus esculentus* L.) is the only vegetable crop in the family Malvaceae and is very popular in India. It is a high-value crop in terms of nutrients important to human health and comprising vitamins, potassium, calcium, carbohydrates, dietary fiber, unsaturated fatty acids and bioactive chemicals. The plants may also showing pharmacological potential and to be known for cure of various serious diseases because of due to antidiabetic, cell reinforcement, anti-adhesive, gastro-protective, hepato-protective, anti-cancer and immuno-modulating activities. The applications of chemical and synthetic fertilizers are more common practices for higher growth and crop productivity, which may lead to health hazards. To overcome these health issues, the application of molasses as organic fertilizer was prescribed by the present investigation. Molasses or black treacle is a viscous byproduct during refining sugarcane or sugar beets into sugar. Molasses contains a concentrated level of the nutrients and minerals that were available in the actual sugarcane. It is especially valued for its iron substance. In spite of that it additionally contains other significant minerals like calcium, magnesium and potassium. In the present investigation, okra plants were sown in Botanical garden soils blended with

different percentages of molasses (w / w) *viz.* 5%, 3%, 1% and 0% (control group). The different attributes of growth of plants were regularly monitored. The present work showed that, soil blended with 5% molasses (w / w) gave profound positive results than the other concentrations and control group as well. That implies supplements present in diluted molasses are fundamental at a specific concentration and consequently compassionate to the plant development. Therefore, the use of diluted molasses or blending of molasses to cropland soils in agriculture may save the expenses of fertilizers and augments the economy of farmers whenever utilized in standard proportion. Therefore, authors wish to recommend the molasses as profound organic fertilizer for eco-friendly farming and sustainable agriculture.

Acknowledgement

Authors are immensely appreciative to Professor & Head, Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala (HR), India for laboratory facilities and critical suggestions during research findings.

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How to cite this article: Singh R, Yadav M, Kumar V, Sharma I, Singh M, Upadhyay SK. (2021). Effect of Molasses on the Growth of Okra, *Abelmoschus esculentus* (L.) Moench (Dicotyledonae: Malvaceae). *Bio-Science Research Bulletin,* 37(1), 4-11.