The Bioscan 11(4): 2453-2456, 2016(Supplement on Agronomy)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

EFFECT OF POST SHOOTING SPRAY OF NITROGEN AND POTASSIUM ON BUNCH CHARACTERS AND FRUIT YIELD OF BANANA CV. GRAND NAINE

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KEYWORDS
Grand Naine
Post shooting spray
Urea
SOP

Received on :
11.08.2016

Accepted on :
26.10.2016

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ABSTRACT
An investigation consists of post shooting spray of Urea (1.00%, 1.50% and 2.00%), SOP (1.00%, 1.50% and 2.00%), as per the package of practice and combination of urea and SOP were sprayed thrice after emergence of flag leaf in banana cv. Grand Naine. Bunch sprayed with combination of SOP (2.00%) and urea (1.00%) increased the bunch characters *viz*., bunch length (84.91 cm), internodal length (12.00 cm), weight of hand (4.04 kg), finger length (23.50 cm), finger girth (13.88 cm), finger weight (189.00 g), bunch weight (34.96 kg) and total yield (107.89 tonnes/ ha). Thus, the study clearly indicates that combined post-shoot spray of SOP (2.00%) with 1.00% urea improves the bunch characters and fruit yield of banana cv. Grand Naine.

INTRODUCTION

Banana (*Musa* sp.) being a gross feeder requires high amount of nutrients for proper growth and production. Under traditional farming system, banana crop receives its last dose of fertilizers (nitrogen and potassium) at 7th month after planting *i.e*. just before shooting, which has to support the requirement of nutrients until harvest since large quantity of photosynthates are to move from the source to the sink *i.e*. developing bunches at this phase. Any limitation in the supply of nutrients at this crucial stage affects the bunch size and quality. Because of this problem, poor filling and development of fingers is often reported. Hence, an additional dose of fertilizer after shooting has become imperative. However, it is not advisable to go for soil application of fertilizers at finger development stage, since the uptake is slow and low at this stage (Veerannah *et al*., 1976). Many reports have indicated the usefulness of post shooting spray of SOP during fruit development on influencing the fruit yield and bunch characters by Algarsamy Ramesh Kumar and Neelakandan (2008) in Robusta, Madhu in banana cv. Grand Naine (2013), Ramesh Kumar and Kumar (2007 and 2010) in cv. Ney Poovan and Ramesh Kumar *et al*. (2008) in cv. Robusta . Besides, urea spray helps in accumulation of more food material in the body of the plant and led to an efficient utilization for the development of fruits (Rajaram, 1975).

Many reports (*i.e*. Ramesh Kumar *et al*., 2008 in cv. Robusta and Ramesh Kumar and Kumar, 2007 and 2010 in cv. Ney Poovan) have indicated the use fulness of post shooting spray of various nutrients during fruit development stage influencing the fruit yield and bunch characters (Kannan, 1980) and also banana has been found to respond well to potassium and nitrogen spray. There fore, there is a need of comparative study to assess the effect of post shooting spray of nitrogen and potassium on bunch characters and fruit yield of banana. Keeping above points in view, the objective of present investigation is to study the effect of post shooting spray of nitrogen and potassium on bunch characters and fruit yield of banana cv. Grand Naine.

MATERIALS AND METHODS

The research was conducted during 2015-16, in the farmer's field at Tulsigeri, Bagalkot district in banana cv. Grand Naine.

The experiment was laid out in a Randomized Complete Block Design (RCBD) with eleven treatments, replicated thrice. The treatment details are given below:

T_1- Control (Water spray)
T_2- Spraying as per package of practice (2,4-D 30ppm)
T_3- Spraying of 1.00% Urea
T_4- Spraying of 1.50% Urea
T_5- Spraying of 2.00% Urea
T_6- Spraying of 1.00% SOP
T_7- Spraying of 1.50% SOP
T_8- Spraying of 2.00% SOP
T_9- Spraying of 1.00% SOP + 2.00% Urea
T_{10}- Spraying of 1.50% SOP + 1.50% Urea

T_{11}- Spraying of 2.00% SOP + 1.00% Urea

The treatments were imposed to the crop during three different stages of crop growth *i.e.,* during shooting, after shooting and 1month after second spray.

Study parameters included: Length of bunch at harvest (cm), internodal length between hands (cm), weight of hand (kg). Weight of the bunch was recorded including the peduncle up to first bract leaf node above the first hand and expressed in kilogram. The total plant yield was calculated by multiplying the yield per plant with the total number of plants per hectare and expressed in tones. The middle fingers in the top and bottom rows of the second hand were selected as representative fingers (Gottreich *et al*., 1964) to record finger length (cm), finger girth (cm) and average weight of the finger (gram). The data was statistically analyzed by method of analysis of variance using RBD as described by Fisher and Yates (1963).

RESULTS AND DISCUSSION

The length of bunch at harvest and internodal length between the hands differed significantly among the treatments (Table 1). The maximum bunch length and internodal length (84.91 and 12.00 cm) was recorded in T_{11} where in bunch was sprayed with two per cent sulphate of potash and one per cent urea which was on par with T_3, T_8 and T_2, where as, the decreased length of bunch and internodal length between hands (66.50 and 8.00cm respectively) was noticed in control (T_1). The increased length of bunch and internodal length between hands might be due to the additional dose of nutrient supplied through urea utilized more for cell elongation rather cell multiplication. And also it might be due to increase in formation and elongation of meristematic tissues since nitrogen is responsible for the formation, growth and development of the cells. The similar results were revealed by Nalina and Kumar (2007) in cv. Robusta and Ancy *et al*. (1998). The increase in length in the potassium treated plants may be due to the action of potassium in translocation of photosynthates to shoots as reported by Kumar *et al*. (2015) in guava cv. Pant prabhat.

The number of hands per bunch did not have any significant difference (Table 1) among the treatments as treatments were imposed to the selected plants during the process of shooting. By the time of spray, the actual differentiation of fingers and hands are well over and hence, there is no likelihood of improving the numbers of hands in Grand Naine**.** In earlier studies by Nandan *et al*. (2011) in banana cv. Nanjangudu Rasabale, Madhu (2013) in banana cv. Grand Naine, Kaviarasu (2013) in banana cv. Grand Naine and Mulagund *et al*. (2015) in banana cv. Nendran also there were no significant improvement in number of hands and fingers.

The hand weight differed significantly among the treatments and the data is presented in Table 1. The weight of hand (4.04 kg) was maximum in the treatment T_{11} (two per cent sulphate of potash and one per cent urea), which was at par with T_3, T_8 and T_2, while, the minimum weight of hand (3.19 kg) was observed in control (T_1). Urea which helped in rapid

Table 1: Effect of post shooting spray on bunch characters of banana cv. Grand Naine.

Tr.No.	Treatment	Bunch length (cm)	Internodal length (cm)	Number of hands per bunch	Weight of hand (kg)
T_1	Control- Water spray	66.50	8.00	8.92	3.19
T_2	Package of practice- 2,4-D (30ppm)	80.29	11.00	8.67	3.89
T_3	Urea (1.00%)	84.08	11.67	8.42	3.95
T_4	Urea (1.50%)	77.71	9.00	8.92	3.42
T_5	Urea (2.00%)	77.58	8.67	9.08	3.21
T_6	Sulphate of potash (1.00%)	76.20	8.33	8.83	3.26
T_7	Sulphate of potash (1.50%)	79.96	9.67	8.58	3.47
T_8	Sulphate of potash (2.00%)	83.08	11.03	8.33	3.92
T_9	Sulphate of potash (1.00%) + Urea (2.00%)	77.58	9.00	8.58	3.39
T_{10}	Sulphate of potash (1.50%) + Urea (1.50%)	78.28	9.33	8.50	3.55
T_{11}	Sulphate of potash (2.00%) + Urea (1.00%)	84.91	12.00	8.33	4.04
	S.Em. ±	2.40	0.35	0.24	0.15
	C.D. at 5 %	7.09	1.03	NS	0.45

NS: Not significant

Table 2 : Effect of post shooting spray on finger characters of banana cv. Grand Naine.

Tr.No.	Treatment	Length of finger (cm)	Girth of finger (cm)	Weight of finger (g)
T_1	Control- Water spray	18.00	11.60	164.40
T_2	Package of practice- 2,4-D (30ppm)	22.33	13.24	181.11
T_3	Urea (1.00%)	22.67	13.31	184.55
T_4	Urea (1.50%)	20.75	12.73	178.42
T_5	Urea (2.00%)	19.67	12.30	174.46
T_6	Sulphate of potash (1.00%)	18.83	12.09	170.22
T_7	Sulphate of potash (1.50%)	21.17	12.42	170.94
T_8	Sulphate of potash (2.00%)	22.50	13.64	182.69
T_9	Sulphate of potash (1.00%) + Urea (2.00%)	19.80	12.12	175.29
T_{10}	Sulphate of potash (1.50%) + Urea (1.50%)	20.00	12.40	179.61
T_{11}	Sulphate of potash (2.00%) + Urea (1.00%)	23.50	13.88	189.00
	S.Em. ±	0.66	0.46	3.17
	C.D. at 5 %	1.96	1.36	9.35

Table 3: Effect of post shooting spray on total yield of banana cv. Grand Naine

Tr.No.	Treatment	Weight of bunch (kg)	Total yield (t/ha)
T_1	Control- Water spray	30.30	93.52
T_2	Package of practice- 2,4-D (30ppm)	33.80	104.31
T_3	Urea (1.00%)	33.98	104.89
T_4	Urea (1.50%)	31.94	98.58
T_5	Urea (2.00%)	30.78	95.00
T_6	Sulphate of potash (1.00%)	31.36	96.79
T_7	Sulphate of potash (1.50%)	31.97	98.68
T_8	Sulphate of potash (2.00%)	33.97	104.86
T_9	Sulphate of potash (1.00%) + Urea (2.00%)	31.04	95.79
T_{10}	Sulphate of potash (1.50%) + Urea (1.50%)	31.58	97.48
T_{11}	Sulphate of potash (2.00%) + Urea (1.00%)	34.96	107.89
	S.Em.±	0.99	3.07
	C.D. at 5 %	2.93	9.06

multiplication and enlargement of cells and greater accumulation of sugars and water in expanded cells leads to increased hands weight and also urea spray which helps in accumulation of more food material in the body of the plant and led to an efficient utilization for the development of fruits. The results are in corroborated with the findings of Nandan *et al*. (2011) in banana cv. Nanjangudu Rasbale, Sharma *et al*. (1990) in mango cv. Langra and Singh and Ahlawat (1996) in ber cv. Umran and Rajaram (1975)in mango cv. Langra.

The results obtained in the experiment with post shooting spray of nutrient mixture on length and girth of finger differed significantly (Table 2). Among the different treatments, T_{11} (two per cent sulphate of potash and one per cent urea) recorded the highest finger length and finger girth (23.50 cm and13.88 cm), which was on par with T_3, T_8 and T_2, while, the shortest finger and lowest girth (18.00 cm and 11.60 cm) was obtained in control (T_1). Increase in length and girth of finger may also be due to complementary action of sulphur on zinc to synthesize auxins which are responsible for the cell elongation by increasing the cell permeability to water and osmotic solutes of the cells. Besides, auxins are also responsible for inducing the synthesis of specific DNA dependent new m-RNA and specific enzymatic proteins causes increased cell plasticity and extension resulting ultimately in cell enlargement (Ahmed *et al*., 1998). The accelerated rate of cell enlargement and formation of larger intercellular spaces during later part of fruit growth leads to increased finger length and girth.

Increased finger length and girth due to SOP was also reported in studies by Nandan *et al*. (2011) in banana cv. Nanjangudu Rasbale, Madhu (2013) in banana cv. Grand Naine, Mustaffa *et al*. (2004), Ramesh Kumar and Kumar (2007) in banana cv. Neypoovan.

Presence of sulphur in sulphate of potash has a synergistic effect with zinc which is essential for cabon dioxide absorption and utilization on synthesis of RNA and auxin which increased the size of fruit. Similar observations were made by Mustaffa *et al*. (2004) in cv. Nendran.

The Grand Naine bunch sprayed with two per cent sulphate of potash and one per cent urea (T_{11}) recorded the maximum finger weight (189.00 g), which was at par with T_3, T_8 and T_2, while the minimum finger weight (164.40 g) was recorded in control (T_1) (Table 2). The increase in finger weight might be due to the rapid multiplication and enlargement of cells and greater accumulation of sugars or carbohydrate and water in expanded cells.

The results obtained from the present investigation, on weight of bunch and yield revealed that, the bunch sprayed with two per cent sulphate of potash and one per cent urea (T_{11}) recorded the highest bunch weight and total yield (Table 3) (34.96 kg and 107.89 t/ha respectively), where as, the lowest bunch weight and total yield (30.30 kg and 93.52 t/ha) was noticed in control (T_1). The increase in weight of bunch and total yield might be due to urea is having favourable influence on yield attributing characters like increasing the fruit length, fruit size and fruit weight of individual fruit. Beneficial effect of nitrogen (urea) in improving yield in pomegranate was noted by Ray *et al*. (2014).

The field trials conducted in the present study clearly pointed out that, the increased total yield was mainly due to improvement in finger weight. The favourable influences on bunch traits by SOP can be because of the presence of sulphur or potassium or both in the SOP. Given as a foliar spray, the absorption of both sulphur and potassium could have played a key role in assimilate partitioning and diversion to the rapidly developing fingers. The role of potassium treatments in increasing fruit weight as well as the greatest tree yield may be due to the catalytic factor of the potassium for many biological processes within trees which reflect on the nutritional status of the trees (Baiea *et al*., 2015).

Increase in weight of hand, weight of bunch and yield per hectare is due to Sulphur present in the sulphate of potash (SOP) might be responsible for the formation of ferridoxin (Iron -sulphur protein) in plants which might have direct impact in activating the catalase and perodoxidase enzymes. Presence of sulphur in SOP had a synergistic effect with zinc, which is essential for carbon dioxide absorption and utilization, synthesis of RNA and auxin. Zinc is also essential for chlorophyll formation, which improves the photosynthetic activity of the crop reported by Pandey and Sinha (1999). SOP has been attributed to play major roles in energy transformation, nitrate assimilation, as a constituent of amino acid and protein production, binding of nucleic acid with proteins, activation of enzymes in carbohydrate metabolism subsequently resulting in greater partitioning of photosynthates in yield attributes of bananas (Ramesh Kumar and Kumar, 2007 and 2010).

Sulphur of Potash is very well known to trigger nitrate reductase in the majority of growth stages. Since nitrate reductase is the key enzyme in the assimilation of nitrate, the maintenance of the high rate of enzyme activity is imperative for enhanced protein content of the plants. The higher yield and yield attributing parameters obtained in the study could have been also brought by the influence on soluble protein too.

The increase in bunch yield and weight due to SOP application in the present study is similar to the earlier findings of Madhu (2013) in banana cv. Grand Naine, Algarswamy and Neelakandan (2008) in Robusta, Nandan *et al*. (2011) in banana cv. Nanjangudu Rasbale and Ramesh Kumar and Kumar (2007 and 2010) in banana cv. Neypoovan.

From the present investigation it is revealed that post shooting application is an instant and effective way of application of nutrients. Application through post shooting spray of major nutrients at critical stages of plant growth significantly influenced yield and bunch characters of banana fruits

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