DOI : 10.5958/0974-0112.2018.00027.0

Indian J. Hort. 75(1), March 2018: 149-152

Short communication

Influence of micronutrients on growth dynamics, fruit yield and quality of Arka Neelamani grape

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ABSTRACT

An investigation was carried out at Bankura, West Bengal on 4-year-old vines of Arka Neelamani planted at 3 m × 2 m on Y-trellis with the objective to study the effect of micronutrients on growth dynamics, yield and fruit quality. There were 11 treatments *viz.*, $ZnSO_4$ at 0.1 & 0.2%; borax at 0.2 & 0.3%; $FeSO_4$ at 0.1 & 0.15%; $CuSO_4$ at 0.1 & 0.15%; $MnSO_4$ at 0.1 & 0.15% and control (water spray). The experiment was conducted following randomized block design having three replications with three vines in each replication. Results of three consecutive years of investigation revealed that micronutrients had significant role in respect of growth dynamics, fruit yield, quality improvement and maintaining the vine vigour. Among the micronutrients, borax and zinc at 0.2% concentration of each played dominant role on various aspect of growth morphogenesis, yield and fruit quality. The treatments not only gave higher fruit production in respect of yield (7.2-8.5 kg), bunch weight (233-289 g) and 10-berry weight (29.1-29.2 g) but also improved the fruit quality in respect of higher TSS/acid ratio (35.4-38.7). The treatments helped for better growth morphogenesis, which resulted in more fruiting spurs (84.1-91.4%) for the current year crop and renewal spurs (85.7-86.2%) for the next year crop. Besides, the treatments maintained the better plant vigour by producing less number of dead shoots.

Key words: Fruit quality, fruit yield, grape, growth dynamics, micronutrients.

Grape (*Vitis vinifera* L), one of the important export oriented fruit crops, commercially grown in Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu and Other northern states in India. Considering its good market demand and high monetary return, attempts have been made to explore its cultivation in non-traditional areas like red and laterite zone of West Bengal where agro-climatic condition is sub-tropical. As a result of concentrated efforts for more than a decade, it was possible to produce quality grapes in some commercial cultivars (Ghosh *et al*., 6) and found Arka Neelamani cultivar performed the best (Ghosh *et al*., 5) in respect of yield and fruit quality. It is well established that successful viticulture requires specific technology which vary from region to region. Among the various agronomical manipulations for sustainable production of quality grapes, micronutrient application is considering one of the vital cultural practices in India. However, specific micronutrients and its dose is vary from place to place (Sindhu *et al.,* 10) even variety to variety in a same place (Prabu and Singaram, 9; Kumar *et al.,* 8). The growth dynamic in grape is an important physiological event which determines the fruit yield not only for the current year but also next year cropping. Considering the important role of micronutrients on vine growth, production and fruit quality, an investigation was, therefore, taken up to know its effect on grape Arka Neelamani.

The investigation was taken up on 4-year-old grape vine cv. Arka Neelamani planted at spacing of 2 m (plant to plant) × 3 m (row to row) at the Horticulture Research and Development Farm, Government of West Bengal, Taldangra, Bankura, West Bengal during the period 2010-13. Geographically, the farm is situated at 23°N latitude and 87°E longitude at an elevation of 88 m amsl. The top soil of the orchard was collected before starting of the experiment and analysed. The pH of the soil was 5.5, available N, P and K were 284.3, 40.3 and 107.7 kg/ha. The plants have been trained on Y trellis system. There were eleven treatments, *viz.*, zinc in the form of $ZnSO_4$ at 0.1%, 0.2%; boron in the form at borax, 0.2 & 0.3%; iron in the form of $FeSO_4$ at 0.1 & 0.15%; copper in the form of $CuSO_4$ at 0.1 & 0.15%; manganese in the form of $MnSO_4$ at 0.1 & 0.15% and control (water spray). The treatments were applied in the form of foliar spray three times, *i.e.* at 4 leaf stage, at fruit set stage and at 10 mm berry size stage. The pH of the spray solution was adjusted by adding required amount of lime and sticker was added in the spray solution. The experiment was conducted following the randomized block design having three replications with three plants in each replication. The plants

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were maintained under uniform cultural practices. The plants were fertilized with 40 kg of FYM, 360 g N, 360 g P_2O_5 and 240 g K_2O/ plant/ year at 3 split doses during first week of February (after pruning), first week of March (after fruit set) and first week of June (after fruit harvest). Timely plant protection measure was taken against pest and diseases as and when it was required. The vines were pruned on 30th January every year at 4 node (spur pruned). Observations were made on different parameters. Five bunches were weighed from each plant and average bunch weight was calculated and expressed in grams. The TSS was measured by hand refractometer while acidity, total sugar and ascorbic acid content of fruit were determined following standard procedures (AOAC, 1).

The results (Table 1) clearly indicated that micronutrients have significant effect on pruned shoots, kept for fruiting (fruiting spur) as well as renewality (renewal spur). Fruitfulness and renewality of spurs (growth dynamic) is directly related to fruit production in the current and subsequent year. It was revealed from the Table 1 that all micronutrient treated vines had higher fruitfulness as compared to control vines. Highest fruitfulness was noted from the vine sprayed with borax at 0.2% (91.4%) followed by borax at 0.3% (84.5%). Zinc sulphate treated plants also showed higher fruitfulness in the spur (84.1 to 82.6%). Lowest fruitfulness of spurs was observed from the control vines (35.1%). Renewability of vegetative spurs after pruning is an important physiological event in the vine that determines the productive for the next year crop. Renewality of vegetative spurs in the vine significantly varied due to micronutrients application. All the micronutrients were effective in increasing renewality of vegetative spurs at either lower or higher dose as compared to control vine. Maximum (88.7%) renewal shoots was noted from the vine spayed with $MnSO_4$ at 0.1% closely followed by the vine with $FeSO_4$ at 0.1% (88.2%). The control plant showed 75.1% renewality (Table 1).

Mortality of fruiting spurs or arms after pruning is a common phenomenon in all the grape growing areas in the country and several factors are responsible for such mortality and anthracnose disease is considered to be important ones (Chadha and Shikhamany, 2). It was observed that the vines sprayed with borax at 0.2% had the lowest spur mortality (3.2%) followed by $ZnSO_4$ at 0.2% (3.5%). Highest spur mortality was noted from the control plants (17.20%). Total shoot mortality was also highest in control vines (10.8%) and lowest in $ZnSO_4$ at 0.2% treated vines (4.8%) followed by borax at 0.2% (5.2%) (Table 1). This observation clearly indicated that micronutrients are helpful in maintaining the plant health by giving less number of dead shoots. Less mortality in micro-nutrient applied vines may be due to the fact that micronutrients impart resistance / tolerance against diseases and pests by improving their own defense system (Edward Raja, 4; Kausadikar and Ismail, 7). Diameter of fruiting shoot did not vary significantly due to different micronutrient treatments (Table 1).

Table 1. Effect of micronutrients on growth dynamics and fruit yield of grape cv. Arka Neelamani.

Treatment	*Fruit-fullness of spur (%)	*Renewality of spur (%)	*Mortality of fruiting spur (%)	*Total shoot mortality (%)	*Diameter of fruiting shoot (cm)	Fruit yield (kg/ vine (1st yr)	Fruit yield (kg/vine (2nd yr)	Fruit yield (kg/vine) (3rd yr)	Fruit yield (kg/ vine) (pooled)
$ZnSO_4$ - 0.1%	82.6	85.9	8.6	8.6	4.5	4.2	6.9	6.7	5.9
$ZnSO_4$ - 0.2%	84.1	86.2	3.5	4.8	4.1	4.9	7.0	7.2	6.4
Borax - 0.2%	91.4	85.7	3.2	5.2	4.3	5.6	8.7	8.5	7.6
Borax - 0.3%	84.5	84.5	5.0	5.5	4.3	5.1	7.9	7.5	6.8
$FeSO_4$ - 0.1%	69.4	88.2	8.8	8.2	4.3	3.6	5.9	6.0	5.2
$FeSO_4$ - 0.15%	67.4	85.0	8.0	8.0	4.2	4.5	6.0	6.2	5.6
$CuSO_4$ - 0.1%	78.6	85.7	9.2	5.7	4.2	4.3	6.5	6.7	5.8
$CuSO_4$- 0.15%	80.3	86.9	9.5	6.5	4.4	4.4	6.2	6.4	5.7
$MnSO_4$ - 0.1%	41.7	88.7	11.6	6.2	4.3	1.8	2.9	5.0	3.2
$MnSO_4$ - 0.15%	60.3	84.6	12.8	6.6	4.5	2.4	3.8	5.5	3.9
Control (Water spray)	35.1	75.1	17.2	10.8	4.1	1.2	2.3	3.5	2.3
CD (P = 0.5)	2.2	5.0	1.3	2.80	N.S.	0.94	1.03	1.04	1.01

*Av. of last two years

Table 2. Effect of micronutrients on bunch weight, 10-berry weight and fruit quality of grape cv. Arka Neelamani.

Treatment	Bunch wt. (g)	10-berry wt. (g)	Juice (%)	TSS (°Brix)	Acidity (%)	TSS: acid ratio	Total sugars (%)	Ascorbic acid (mg/100 ml)
$ZnSO_4$ - 0.1%	224	28.9	72.2	17.5	0.52	33.7	13.0	2.9
$ZnSO_4$ - 0.2%	233	29.1	73.4	18.2	0.47	38.7	13.2	3.6
Borax - 0.2%	289	29.2	73.5	17.7	0.50	35.4	13.1	3.2
Borax - 0.3%	266	28.0	73.0	17.2	0.52	33.1	13.8	3.3
$FeSO_4$ - 0.1%	262	32.6	75.8	18.0	0.54	33.3	12.9	3.2
$FeSO_4$ - 0.15%	245	32.5	75.5	18.3	0.52	35.2	13.0	3.1
$CuSO_4$ - 0.1%	265	28.8	73.9	16.7	0.53	31.5	12.1	3.7
$CuSO_4$ - 0.15%	230	28.5	74.5	16.0	0.53	30.2	12.3	3.4
$MnSO_4$ - 0.1%	210	30.1	75.5	15.5	0.55	28.2	12.0	3.4
$MnSO_4$ - 0.15%	211	28.5	75.0	16.0	0.56	28.6	13.0	3.8
Control (Water spray)	179	26.0	72.4	15.5	0.50	31.0	12.4	3.0
CD (P = 0.5)	25.5	1.7	NS	0.9	NS	2.3	NS	NS

*Av. of last two years

Results from three consecutive years of investigation revealed that micronutrients had significant role in yield increment over control (Table 1). Average highest yield was recorded from the plant sprayed with 0.2% borax (7.6 kg/vine) followed by 0.3% borax (6.8 kg/vine) and 0.2% $ZnSO_4$ (6.4 kg/vine). The result was close conformity with the findings of Prabhu and Singaram (9) who also recorded highest yield in Mucat grape with foliar application of $ZnSO_4$ + borax. Highest yield from the boron or zinc treated vines was due to more number of fruiting spurs as compared to other treatments. The control vines gave fruit yield of 2.3 kg/vine only. Yield increment due to boron (as borax) or zinc (as $ZnSO_4$) may be attributed to the fact that zinc in grape is required for normal development of leaf, shoot elongation, pollen formation, fruit set and berry development (Christensen, 3). Edward Raja (4) opined that zinc is highly immobile in soil and its deficiency is common in many fruit crops like grape, pomegranate, etc. So, it is assumed that additional zinc application may result in higher berry yield as observed during the period of investigation. Boron is essential for regular carbohydrate metabolism. It is also important for pollen germination, growth of pollen tube and normal fruit set (Chadha and Shikhamany, 2). Besides, boron is essential for formation of inflorescence primordia (Christensen, 3). It was noted that all the micro-nutrient treated vines gave higher yield as compared to control in all the years.

It was observed from the data in Table 2 that micronutrient specially boron (as borax) at 0.2% was found to be the superior as it produced highest weighable bunch (289 g) as compared to other treatments. 10-berry weight was recorded higher in all the micronutrients sprayed vines as compared to control (Table 2). Higher 10-berry weight (32.6 to 32.5 g) was measured from the vines sprayed with $FeSO_4$ (0.1 to 0.15%). Fruit quality in grapes is expressed mainly as T.S.S./acid ratio and juice content. TSS/acid ratio indicates the organoleptic taste of the fruit which appeal the consumers' acceptance. Higher TSS/acid ratio (38.7) was calculated from the vines sprayed with 0.2% $ZnSO_4$ at followed by 0.2% borax (35.4). Prabhu and Singaram (9) also observed with higher TSS/acid ratio in Muscat grape with foliar application of 0.5% $ZnSO_4$ and 0.2% borax. Higher TSS content in berry in micro-nutrients sprayed vines may be due to more intensive transformation of starch into sugar and its translocation into berry (Kumar *et al*., 8).

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Received : January, 2017; Revised : November, 2017; Accepted : January, 2018