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Effect of different sources and method of potassium application on growth and yield of grapes cv. Sharad seedless (*Vitis Vinifera* L.)

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Abstract
In the present study on growth and yield of grapes cv. Sharad Seedless different sources and methods of potassium were applied. The experiment was laid out with eight treatments replicated four times in Completely Randomized Block Design at the ICAR-Indian Institute of Horticultural Research, Bengaluru in 2016-17. Three different sources of potassium fertilizers *viz.*, sulphate of potash (SOP), potassium nitrate (KNO_3) and 19: 19: 19 and two methods of application *viz.*, soil application and fertigation were applied to Grape vines. Among the treatments, highest mean pruned biomass (1.47 kg vine^{-1}) and yield vine^{-1} (7.42 kg) were recorded in vines treated with 40% KNO_3 through fertigation + 60% SOP through soil and lowest yield vine^{-1} (5.21 kg) was observed in vines treated with 100% SOP through fertigation. Vines, which received 60% KNO_3 through fertigation + 40% SOP through soil, had recorded maximum percent of fruitful canes vine^{-1} (51.31).

Keywords: Grape, potassium fertilizers, sulphate of potash, potassium nitrate, soil application, fertigation and yield

Introduction

Grape (*Vitis vinifera* L.) is one of the most important fruit crops having agronomic and economic importance (Ruel and Walker, 2006). The fertilization of grapevine is very important practice that affects the production in terms of both quality and quantity (Jackson and Lombard, 1993). Nutrition has conclusively determined the productivity of grapevines under Indian conditions. The nutrient use efficiency of N ranged from 20% to 40%, P from 5% to 20% and K from 50% to 100%, depending on the variety, growth rate and production potential. Potassium (K) is one of the important essential elements for vine growth and yield. Adequate status of K has been emphasised for formation of fruitful buds at bud initiation and differentiation stage (Bhargava and Sumner 1987) [9] and at bud fixation after differentiation (50 to 55 days after pruning) and at cane maturity (Winkler *et al*., 1974) [10]. Grape growers are applying fertilizers through soil and also through fertigation. But, the information on to what extent they can apportion the fertilizer application through these methods to improve nutrient us efficiency is not available. Hence, a field experiment was conducted during 2016-17 to study the effect of combined application of different sources of potassium (SOP, KNO_3 and 19 all) and their method of application (direct soil application and fertigation) on growth, yield and quality on cv. Sharad Seedless.

Materials and methods

The present experiment was laid out in Randomized Block Design (RBD). Eight different combinations of treatments (Table. 1) with four replications were imposed in an annual growth cycle of the vine. Each treatment in a replication comprised of six vines. Soil application was done once in 15 days from 75 days after pruning till 120 days and fertigation was done once in 3 days from 75 days till 120 days in all the treatments. The other nutrient elements were applied as per the recommended dose. "Two pruning and single cropping" system of grape cultivation was followed as this is the standardized method of grape cultivation for the region. The summer pruning is popularly called as back or foundation pruning, which was done on 3rd May while, the winter pruning is called as forward or fruit pruning which was done on 3rd- 4th October.

Table 1: Treatment details

Notation	Treatments
T_1	100% SOP through soil
T_2	60% SOP through fertigation + 40% SOP through soil
T_3	60% KNO_3 through fertigation + 40% SOP through soil
T_4	60% 19: 19: 19 through fertigation + 40% SOP through soil
T_5	40% SOP through fertigation + 60% SOP through soil
T_6	40% KNO_3 through fertigation + 60% SOP through soil
T_7	40% 19: 19: 19 through fertigation + 60% SOP through soil
T_8	100% SOP through fertigation

Statistical analysis

The data was presented as arithmetic means of four replications. The significance of given treatments on growth and yield were determined by using one-way ANOVA statistics. Duncan's multiple range test (DMRT) was used to differentiate the means at p=0.05.

Results and discussion

Results were presented in Table.2. During back pruning, there was no significant difference between the treatments for pruned biomass (kg vine^{-1}), sprouting percentage and potassium content in canes (%). During forward pruning significant effect of treatments on growth parameters had been observed. The maximum pruned biomass (1.47 kg vine^{-1}) was observed in vines treated with T_6 treatment (40% KNO_3 through fertigation + 60% SOP through soil and T_3, T_7, T_1 and T_4 treatments were on par with T_6. Whereas, minimum pruned biomass (1.25 kg vine^{-1}) had renewed in vines of T_2 treatment (60% SOP through fertigation + 40% SOP through soil).

Significantly highest sprouting percentage (61.38%) was recorded in treatment T_2 (60% SOP through fertigation+40% SOP through soil) which was on par with all other treatments except T_4 and T_1 whereas, the lowest sprouting percentage (51.06%) was observed in T_4 (60% 19:19:19 through frtigation+40% SOP through soil). The maximum mean value of potassium content in canes (0.75%) was recorded in T_5 treatment (40% SOP through fertigation+60% SOP through soil) which was on par with T_2, T_6 and T_7 while the minimum value (0.55%) was observed for T_8 (100% SOP through fertigation).

Treatment T_3 (60% KNO_3 through fertigation+40% SOP through soil) recorded maximum percent of fruitful canes vine^{-1} (51.31%) followed by T_6, T_5, T_7, T_4 and T_1 respectively which were on par with each other. Whereas, lowest percent of fruitful canes vine^{-1} (36.13%) was observed for the treatment T_2 (60% SOP through fertigation + 40% SOP through soil) which was on par with T_8. Vines treated with treatment T_6 (40% KNO_3 through fertigation+60% SOP through soil) recorded significantly highest yield vine^{-1} (7.42 kg) which was at par with the treatments T_3, T_7, T_5 and T_4. Whereas, T_8 treatment (100% SOP through fertigation) had recorded the lowest yield vine^{-1} (5.21 kg).

Irrespective of method of application treatments consisted with combination of KNO_3 and SOP i.e., T_6 (40% KNO_3 through fertigation+60% SOP through soil) and T_3 (60% KNO3 through fertigation+40% SOP through soil) resulted maximum pruned biomass, percent of fruit full canes vine^{-1}and yield vine^{-1} (kg) when compared to other treatments. This might be due to presence of nitrogen along with potassium in the form KNO_3. Nitrogen stimulates vegetative growth and promotes development of large stems, leaves and other vegetative parts. Potassium was concomitant of intensive metabolic activity. This was expressed morphologically as increased vine growth. Pruning weight was measure of overall growth of the grapevines (Bouard, 1968) [3]. Present results are in agreement with the findings of Ahmed (2003) [2] and Khandagale *et al*. (1977) [1] as they observed soil application of potassium as SOP increased pruned weight in Thompson seedless grapes. Increased yield in T_6 treatment could be due to increased photosynthesis activity due to adequate supplies of potassium along with nitrogen. Potassium was essential for photosynthesis as it involved in enzyme activation and adenosine triphosphate (ATP) production and nitrogen plays a vital role to increase chlorophyll content. Present results are in same line with the findings of Schreiner *et al*. (2013) [8], who noted the increment in yield with application of potassium as KNO_3 at 50%, when compared to full nutrition. Kang *et al*. (2011)[5] also reported 30% potassium as top dressing and 35% of potassium as fertigation gave higher yields in Campbell Early grapevines. Various investigation also proved, soil application of potassium in form of SOP, increased the grape yields (El-Boray *et al.*, 1996; Gopalaswamy and Rao, 1972; Samra *et al*., 2007) [4, 6, 7].

Conclusion

The present study had revealed that irrespective of method of application, the treatments consisted with combination of KNO_3 and SOP i.e., T_6 (40% KNO_3 through fertigation+60% SOP through soil) and T_3 (60% KNO3 through fertigation+40% SOP through soil) were proved effective among the treatments by not only with highest mean pruned weight, percent fruitfulness but also with highest yield vine^{-1}.

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Table 2: Effect of different sources and method of potassium fertilizers application on growth and yield parameters in grapes cv. Sharad Seedless

Treatment	Pruned biomass (kg vine^{-1})		Sprouting percentage (%)		Potassium content in canes (%)		Percent of fruit full canes vine^{-1} (%)	Yield vine^{-1} (kg)
	Back Pruning	Forward Pruning	Back Pruning	Forward Pruning	Back Pruning	Forward Pruning		
T_1	3.29	1.38^{abc}	59.47	54.59^{bc}	0.52	0.64^{bc}	45.52^{ab}	6.00^{bc}
T_2	3.75	1.25^{d}	58.84	61.38^{a}	0.44	0.67^{ab}	36.13^{c}	5.88^{bc}
T_3	3.81	1.42^{ab}	59.72	56.97^{ab}	0.48	0.62^{bc}	51.31^{a}	7.04^{ab}
T_4	4.05	1.35^{abcd}	55.17	51.06^{c}	0.45	0.61^{bc}	45.77^{ab}	6.25^{abc}
T_5	4.36	1.31^{bcd}	58.73	57.45^{ab}	0.45	0.75^{a}	46.66^{ab}	6.46^{ab}
T_6	3.84	1.47^{a}	57.87	55.92^{abc}	0.5	0.66^{ab}	49.93^{a}	7.42^{a}
T_7	4.50	1.40^{abc}	53.46	59.30^{ab}	0.49	0.65^{ab}	45.85^{ab}	6.50^{ab}
T_8	3.68	1.28^{cd}	59.98	57.50^{ab}	0.38	0.55^{c}	40.20^{bc}	5.21^{c}
S.E.m.±	0.27	0.04	4.03	1.93	0.04	0.03	2.86	0.42
C.D. 5%	NS	0.13	NS	5.68	NS	0.10	8.40	1.23
C.V.	13.64	6.37	13.91	6.81	17.92	10.55	12.64	13.15

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