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INFLUENCE OF NITROGEN, PHOSPHORUS AND POTASSIUM FERTILIZERS ON YIELD AND QUALITY OF GRAPES CV. PERLETTE

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ABSTRACT: The present studies were conducted to ascertain the effect of different combinations of N, P and K fertilizers on the yield and quality of Perlette grapes. The yield and quality characteristics varied with the different combinations of N, P and K. The mean pooled data indicates that the maximum number of bunches/vine (2.28) were obtained in $N_1P_1K_1$ combination. The mean bunch weight was however, significantly higher (497.2g) in a fertilizer combination $N_1P_2K_2$ followed by combination $N_1P_1K_2$ (469.3). The higher yield /vine (10.3 kg) was obtained in $N_1P_2K_2$ combination. The quality parameters viz., TSS, acidity and TSS/Acid ration also varied with change in fertilizer dose. The significantly higher TSS (19.1%) was obtained in the bunches harvested from the vines given 75g N, 50 g P and 150 g K. The TSS/Acid ratio was significantly higher (37.3). Thus the fertilizer combination $N_1P_1K_2$ (75g N, 50 g P and 150 g K)/ year age of vines should be recommended in vineyards to obtain higher yield and better quality fruits.

Keywords : *Grapes, nitrogen, phosphorus, potassium, growth, quality.*

Grapes produce higher yields and fetch extra farm income per unit area than most field and fruit crops. High yield of fruits exhausted the plant and soils essential elements needed for proper growth and development. Hence, various elements are required to be replenished regularly in sufficient quantity to keep the fruit tree in healthy and productive condition. Nutrient removal by fruits and its use efficiency indicate mining of nutrients from soil (Hedge and Sudkara Babu, 4 and Patil *et. al*., 6). 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. In grapevines, nitrogen has shown its effect in terms of growth, P in fruit bud differentiation and root growth and potassium for cane maturity, crop quality and shelf-life of bunches. It is not N, P and K concentration, which individually affect bud differentiation but a proper balance between them induces the bud either to develop into a fruitful bunch or a non-productive tendril (Bhargava, 1). Keeping in view of these the present study was therefore undertaken to know the effect of N, P and K application and their interaction on the quality and yield performance of grapes.

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MATERIALS AND METHODS

The experiment was conducted at New orchard, Punjab Agricultural University, Ludhiana. In the trial, NPK doses in 27 different combinations were tested on the grapes cv. Perlette. Urea (46% N) was used as a source of nitrogen and was added as 0, 75, 150 g (N_0, N_1, N_2) nitrogen/ year age of vines. While, super phosphate (16% P_2O_5) was used as 0, 50, 100g (P_0, P_1, P_2) phosphorus/year age of vines. Murate of potash (MOP) was used as a source of potash to have 0, 75, 150g (K_0, K_1, K_2) potash/year age of vines. The entire dose of phosphorus and half dose of nitrogen and potassium were applied in February and remaining dose of nitrogen and potassium was given in month of April at full bloom. The crop was harvested in the first fortnight of June at berry ripening stage. The fruit yield attributes such as number of bunches/vine, bunch weight, berry weight, yield per vine and quality parameters such as T.S.S., Acidity, T.S.S./acid ratio and brix yield were recorded for the three fruiting years viz., 2002-03, 2003-2004 and 2004-05. The experiment was laid out in Factorial RBD with three replications.

RESULTS AND DISCUSSION

Yield Attributes

The data pertaining to yield and yield attributes of fruits as influenced by the application of different levels of N, P and K in grapes are presented in Tables 1&2. Nitrogen, phosphorus and potassium application to grapes showed beneficial effect on fruit yield. During 2002-03, the maximum no. of bunches per vine (20.6) were obtained in $N_0P_1K_0$ combination, which was closely followed by $N_1P_1K_1$ combination. While during the years 2003-04 and 2004-05, significantly higher no. of bunches per vine (21.6) and (29.3) were obtained in combination $N_1P_1K_1$ (75 g N, 50 g P and 75 g K) and $N_1P_1K_2$ (75 g N, 50 g P and 150 g K) respectively. The maximum bunch weight (546 g) during 2002-03, was obtained in $N_1P_2K_2$ combination, where 75 g N, 100 g P and 150 g K was applied per year age of vines. Potassium promotes fruitfulness through activating the enzymes involved in the conversion of carbohydrates to ribose sugar, which is a component of RNA. Application of potassium was found to increase the bunch number per vine (Gopalswamy and Madhav Rao, 3). Consequently, the maximum yield per vine (8.89 kg) was also obtained in the same combination. As far as the bunch weight is concerned in the year 2003-04 and 2004-05, the similar trend was noticed, where the highest bunch weight of 390g and 555.6g, respectively was also obtained $N_1P_2K_2$ fertilizer combination. Sidhu and Thakur (7) had also reported an increase in bunch weight with higher levels of N-P-K . The bunch weight in this combination was significantly higher than combination $N_1P_1K_1$ where maximum number of bunches/ vine was obtained. In 2003-04, the maximum yield (7.06 kg) was obtained in $N_2P_0K_0$ combination, while it was at par with $N_1P_2K_2$ (7.02) and $N_1P_1K_2$ (6.90). The higher yield/vine (15.1kg) was obtained in $N_1P_1K_2$ combination where 75 g N , 100 g P and 150 g K was applied to the plants during 2004-05. Potassium has an additive effect in increasing the bunch number per vine along with N. Quaggio *et al.* (8) had also reported that P and K were the most effective nutrients to increase fruit size. The berry weight had a different trend than the bunch weight and yield/ vine; it was highest 210g, 343g and 295g in $N_1P_1K_2$ combination, where 75g N, 50g P and 150 g K were added per year age of the vines during the three consecutive years 2002-05.

Fruit Quality Attributes

In general, the different fertilizer combination of NPK had a varied effect on the fruit quality parameters. The maximum T.S.S. (19.0) was obtained (Table 3) in bunches, from the vines, which were given $N_1P_1K_2$ fertilizer application. Likewise, in the year 2003-04 and 2004-05, the highest percent T.S.S. of 19.3 and 19.0 was also obtained in the same combination. This may be due to the reason that adequate K is needed for translocation of sugars to the berries. Though, the trend is clear that the highest T.S.S. is obtained when 75 g N, 50 g P and 150 g K was applied per year age of the vines. However, the T.S.S. obtained was at par with that obtained in the combinations $N_0P_1K_2$, $N_1P_2K_1$ and $N_1P_2K_2$ in 2002-03 and $N_1P_2K_0$, $N_1P_2K_2$ in 2003-04. Potassium influenced berry quality attributes more than other applied mineral elements (Mohammad and Esmaeil, 5). Faruqi and Satyanarayana (2) had also reported reduction in the acidity of the juice in Anab-e-Shahi due to potassium.

Although, the percentage acidity ranged from 0.46-0.60 (2002-03), 0.50-0.64 (2003-04) and 0.46-0.62 (2004-05), but it was at par in all the combinations tried in three years. Among different NPK combinations tried, the highest T.S.S./acid ratio (39.1) was obtained in $N_1P_2K_1$ combination, closely followed by $N_1P_1K_2$ combination, which was also the best combination to yield highest T.S.S/acid ratio (35.0 and 39.0) in 2003-04 and 2004-05 respectively (Table 4). The maximum brix yield (162.6) in 2002-03, was obtained in $N_1P_2K_2$ combination, while in 2003-04 and 2004-05, the maximum brix yield of 133.1 and 279.5 was

Table 1: Effect of different fertilizer combinations on yield attributes in grape cv. Perlette.

Fertilizer Combinations	Yield attributes					
	No. of bunches/vine			Bunch weight (g)		
	2002-03	2003-04	2004-05	2002-03	2003-04	2004-05
$N_0P_0K_0$	11.6	15.6	21.0	285.0	313.3	291.0
$N_0P_0K_1$	17.0	16.3	20.3	322.0	300.0	302.3
$N_0P_0K_2$	16.3	16.0	18.6	374.6	280.0	314.0
$N_0P_1K_0$	20.6	18.0	169.3	327.6	350.0	322.6
$N_0P_1K_1$	16.3	16.6	18.3	359.0	309.0	337.6
$N_0P_1K_2$	15.0	15.3	17.0	402.0	313.3	332.0
$N_0P_2K_0$	12.0	16.3	18.6	302.0	323.3	348.6
$N_0P_2K_1$	17.0	17.3	18.3	356.0	333.6	362.0
$N_0P_2K_2$	16.0	15.3	20.3	352.0	330.0	416.0
$N_1P_0K_0$	11.3	16.0	22.3	393.3	353.3	412.0
$N_1P_0K_1$	12.0	16.6	25.0	511.6	318.3	419.6
$N_1P_0K_2$	12.6	14.6	27.0	524.0	270.0	441.3
$N_1P_1K_0$	12.3	19.6	28.0	411.0	363.3	435.3
$N_1P_1K_1$	20.0	21.6	27.0	411.6	305.3	510.0
$N_1P_1K_2$	12.6	18.3	29.3	529.0	377.3	501.6
$N_1P_2K_0$	18.0	19.0	28.0	456.3	356.6	481.6
$N_1P_2K_1$	10.6	14.3	28.0	540.3	350.0	430.0
$N_1P_2K_2$	19.3	18.0	27.3	546.0	390.0	555.6
$N_2P_0K_0$	19.3	19.0	25.6	310.0	371.6	425.0
$N_2P_0K_1$	9.3	12.3	24.3	305.6	336.0	434.3
$N_2P_0K_2$	18.3	17.3	22.0	512.6	319.6	417.3
$N_2P_1K_0$	16.0	17.3	22.0	331.0	353.3	407.6
$N_2P_1K_1$	18.6	18.6	18.0	297.0	296.0	391.0
$N_2P_1K_2$	11.6	16.6	18.6	356.6	372.3	382.0
$N_2P_2K_0$	13.3	17.3	20.3	361.3	363.3	373.3
$N_2P_2K_1$	13.3	16.3	20.0	346.3	359.6	363.3
$N_2P_2K_2$	9.0	16.0	18.6	371.6	320.0	331.0
CD (P=0.05)	1.31	1.96	1.73	9.2	8.5	8.7

Table 2 : Effect of different fertilizer combinations on yield attributes in grape cv. Perlette.

Fertilizer Combinations	Yield attributes					
	Berry weight (g)			Yield/ vine (kg)		
	2002-03	2003-04	2004-05	2002-03	2003-04	2004-05
$N_0P_0K_0$	175.0	290.0	193.3	3.30	4.88	6.1
$N_0P_0K_1$	185.0	276.6	205.3	5.47	4.89	6.1
$N_0P_0K_2$	140.0	266.6	201.6	6.10	4.48	5.8
$N_0P_1K_0$	150.0	243.3	200.0	6.74	6.30	5.2
$N_0P_1K_1$	93.3	240.0	206.6	5.85	5.12	6.1
$N_0P_1K_2$	166.6	290.0	195.0	6.03	4.79	5.6
$N_0P_2K_0$	163.3	273.3	205.0	3.62	5.26	6.5
$N_0P_2K_1$	183.3	253.3	212.0	6.02	5.82	6.6
$N_0P_2K_2$	180.0	280.0	199.3	5.63	5.04	8.4
$N_1P_0K_0$	183.3	260.0	207.3	4.44	5.65	9.1
$N_1P_0K_1$	180.0	280.0	209.6	6.13	5.28	10.4
$N_1P_0K_2$	196.6	250.0	210.3	6.60	3.94	11.9
$N_1P_1K_0$	180.0	280.0	225.6	5.05	6.62	12.1
$N_1P_1K_1$	173.3	276.6	265.0	8.23	6.59	13.7
$N_1P_1K_2$	210.0	343.3	295.0	6.66	6.90	14.7
$N_1P_2K_0$	205.0	293.3	271.0	8.21	6.77	13.4
$N_1P_2K_1$	206.6	300.0	275.0	5.72	5.00	12.0
$N_1P_2K_2$	186.6	250.0	283.3	8.89	7.02	15.1
$N_2P_0K_0$	158.3	306.6	255.0	5.98	7.06	10.9
$N_2P_0K_1$	175.0	246.6	238.3	2.84	4.13	10.5
$N_2P_0K_2$	200.0	263.3	234.0	7.07	5.52	9.17
$N_2P_1K_0$	171.6	303.3	216.0	5.29	6.11	8.1
$N_2P_1K_1$	121.6	246.6	206.0	4.89	5.50	7.0
$N_2P_1K_2$	176.6	273.3	190.6	4.13	6.18	7.1
$N_2P_2K_0$	155.0	273.3	184.0	4.80	6.28	7.5
$N_2P_2K_1$	173.3	270.0	176.6	4.60	5.86	7.2
$N_2P_2K_2$	171.6	260.0	163.3	3.34	5.12	6.1
CD (P=0.05)	12.3	14.1	15.8	0.21	0.18	0.42

Table 3: Effect of different fertilizer combinations on fruit quality in grape cv. Perlette.

Fertilizer Combinations	Fruit quality parameters					
	T.S.S. (%)			Acidity (%)		
	2002-03	2003-04	2004-05	2002-03	2003-04	2004-05
$N_0P_0K_0$	16.5	16.6	14.6	0.58	0.54	0.58
$N_0P_0K_1$	15.1	15.6	15.3	0.55	0.50	0.61
$N_0P_0K_2$	15.6	16.3	14.6	0.48	0.55	0.62
$N_0P_1K_0$	18.0	16.6	15.0	0.47	0.64	0.57
$N_0P_1K_1$	15.6	15.3	15.6	0.48	0.62	0.57
$N_0P_1K_2$	18.3	17.3	15.3	0.52	0.54	0.61
$N_0P_2K_0$	18.1	18.0	14.3	0.58	0.54	0.56
$N_0P_2K_1$	16.1	17.3	14.6	0.53	0.52	0.56
$N_0P_2K_2$	16.6	17.0	15.3	0.50	0.58	0.60
$N_1P_0K_0$	16.8	16.3	15.3	0.55	0.63	0.58
$N_1P_0K_1$	17.3	15.0	15.0	0.55	0.54	0.60
$N_1P_0K_2$	15.1	15.0	16.3	0.52	0.54	0.54
$N_1P_1K_0$	15.5	17.6	16.6	0.51	0.60	0.54
$N_1P_1K_1$	17.1	16.0	17.0	0.53	0.59	0.50
$N_1P_1K_2$	19.0	19.3	19.0	0.50	0.55	0.48
$N_1P_2K_0$	17.8	18.6	17.3	0.55	0.56	0.48
$N_1P_2K_1$	18.5	17.0	16.6	0.47	0.54	0.49
$N_1P_2K_2$	18.3	18.3	18.0	0.52	0.55	0.47
$N_2P_0K_0$	16.8	17.3	17.3	0.60	0.59	0.46
$N_2P_0K_1$	16.3	16.3	16.6	0.58	0.63	0.49
$N_2P_0K_2$	17.3	17.0	17.0	0.46	0.55	0.53
$N_2P_1K_0$	17.0	17.3	16.6	0.56	0.53	0.54
$N_2P_1K_1$	15.0	16.3	17.0	0.53	0.63	0.49
$N_2P_1K_2$	17.8	15.6	16.3	0.48	0.56	0.49
$N_2P_2K_0$	16.0	16.3	16.3	0.52	0.54	0.50
$N_2P_2K_1$	17.1	15.0	15.6	0.50	0.52	0.53
$N_2P_2K_2$	16.0	16.3	16.0	0.54	0.55	0.56
CD (P=0.05)	0.71	0.93	0.88	0.21	0.19	0.22

Table 4: Effect of different fertilizer combinations on fruit quality in grape *cv*. Perlette.

Fertilizer Combinations	Fruit quality parameters					
	T.S.S/acid ratio			Brix yield (kg/vine)		
	2002-03	2003-04	2004-05	2002-03	2003-04	2004-05
$N_0P_0K_0$	28.1	31.3	25.2	54.4	81.0	89.5
$N_0P_0K_1$	27.5	31.0	24.6	84.7	76.2	94.2
$N_0P_0K_2$	32.2	29.6	23.6	95.1	73.0	85.9
$N_0P_1K_0$	37.9	25.4	26.0	121.3	104.5	78.9
$N_0P_1K_1$	32.2	24.8	27.2	91.2	78.3	99.0
$N_0P_1K_2$	35.2	32.0	25.1	110.3	82.8	86.4
$N_0P_2K_0$	30.9	33.4	25.5	65.5	94.6	93.2
$N_0P_2K_1$	34.1	33.4	26.2	96.9	100.6	97.3
$N_0P_2K_2$	33.3	29.0	25.3	93.4	85.6	129.6
$N_1P_0K_0$	30.5	26.4	26.3	74.5	92.0	140.9
$N_1P_0K_1$	31.5	28.0	24.7	106.0	79.2	157.2
$N_1P_0K_2$	29.2	27.8	30.1	99.6	109.5	194.5
$N_1P_1K_0$	30.4	29.4	30.8	78.2	125.3	203.1
$N_1P_1K_1$	32.3	26.7	34.0	140.7	105.4	232.9
$N_1P_1K_2$	38.0	35.0	39.0	126.5	133.1	279.5
$N_1P_2K_0$	32.4	33.1	36.1	146.1	125.9	233.8
$N_1P_2K_1$	39.1	31.5	33.8	105.8	85.0	199.2
$N_1P_2K_2$	35.3	33.3	38.0	162.6	128.4	273.2
$N_2P_0K_0$	28.0	28.3	37.6	100.4	122.1	188.9
$N_2P_0K_1$	27.8	25.7	33.6	46.2	67.3	176.1
$N_2P_0K_2$	37.6	30.8	32.0	122.3	93.8	155.9
$N_2P_1K_0$	30.3	32.7	30.8	89.9	105.7	135.7
$N_2P_1K_1$	28.3	25.8	34.4	73.3	89.6	119.5
$N_2P_1K_2$	36.6	27.8	33.1	73.5	96.4	116.5
$N_2P_2K_0$	30.7	30.4	33.3	76.8	102.3	126.5
$N_2P_2K_1$	34.3	28.5	29.6	78.6	87.9	113.6
$N_2P_2K_2$	29.5	32.1	28.5	53.4	83.4	98.7
CD (P=0.05)	1.08	1.24	1.20	9.65	7.25	5.38

obtained in $N_1P_1K_2$ where 75 g N, 50g P and 150 g K was applied to the vines.

It can be concluded from three year data on fertilizer trail, that highest T.S.S, the T.S.S/acid ratio and the brix yield was obtained in the combination $N_1P_1K_2$, where 75g N, 50 g P and 150 g K was added to the plants. While the maximum yield/ vine was obtained in the combination $N_1P_2K_2$, where 75g N, 50 g P and 150 g K was applied to the plants.

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