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Berry Chemical Composition Characteristics of 'Cola II' Red Raspberry As Affected by Application of Nitrogen Fertilizers and Organic Manure

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Abstract
A research was conducted to evaluate the effect of nitrogen rate and application time, and effect of sheep manure application on the berry composition and cane characteristics of 'Cola II' red raspberry. N rates of 56 and 112 kg.ha^{-1} were applied as ammonium nitrate. The 112 kg.ha^{-1} rate was applied as single application and split application. Sheep manure at 30 and 40 kg.ha^{-1} was applied in single applications. Increasing N rates increased the berry concentration. However, ıt had no effect noo other characteristics. N and Sheep Manure (SM) rates have no significant effect on crude protein content, total dry weight, seed percentage, soluble solid concentration and N content. Crude protein from 4.94 to 5.41%. Nitrogen rate of 112 kg ha^{-1} increased K content and total acidity however, no difference was observed among.

Key words : *Rubus idaeus* L., Tokat province, N fertilizer, organic manure

INTRODUCTION

Raspberries have been grown and consumed for years in the world, although they are new to Turkey. Cultivars may be classified either by berry color or berrying habit. Raspberries may also be classified as summer-bearing (floricane berrying) or everbearing (fallbearing). Summer-bearing cultivars produce one crop in early summer (Primocane), while ever-bearing cultivars can produce up to two crops a year, one crop being produced in the summer(floricane) and the second crop in the fall (primocane). In midsummer, after the raspberries have finished berrying, all canes that bore berry should be removed. These old canes (floricane) will die the fallowing winter since the canes of raspberries live only two years. In summer-bearing cultivars, the first year canes (primocane) grow from a shoot starting from the root. The second year these canes (floricane) berry and then die[1,2].

Nitrogen fertilizer is an important input in raspberry and blackberry production. Much research has focused on its effect on growth and yield. Where yields were increased by N and K, postharvest quality response varied. Martin and Nelson[3] applied 0 and 67 kg N ha^{-1} and 135 kg N ha^{-1}. They found that soluble solids concentration (SSC) was lower and individual berry mass was higher with N at 67 kg.ha^{-1}. Berry pH and titratable acidity (TA) were not affected by N and K rates. However, work on N partitioning in 'Chester Thornless' blackberry demonstrated that the berry was the strongest sink for newly applied N fertilizer in plant[4]. In Alleyne and Clark[5] reports, levels of N rate and time application were at 56 or 112 kg.ha^{-1} in single applications, or at 112 kg.ha^{-1} as a split appplication with 0 kg.ha^{-1} as the control. Among N treatments, no significant effect was detected for solible solid concentration (means ranged from 8.8% for the full application to 9.2% in the control), and total solids (means ranged from 13.7% in both full applications to 15.0% in the control). In general, high levels of N had a negative effect on quality of berrys[6,7].

In general, it is assumed that only 50% of the nitrogen in most manure or compost will be available during the year of application (The availability of nitrogen in fresh poultry manure may be closer to 90% in the first year). However, the remaining nitrogen will become available in subsequent years and should be credited accordingly[8]. The for need large amounts of organic matter added to the soil for maximum bramble production cannot be stressed enough. Nine to ten tons of manure can be added per acre each year. Even though the manure will provide nitrogen to the crop, 30 to 40 pounds(15-20 kg) of nitrogen should still be broadcast in late March[9].

The objective of this work was to evaluate the effect of N rate and timing of application and dry sheep manure (SM) on berry (*seed+berry flesh*) composition of 'Cola II' red raspberry (*Rubus idaeus* L.) cultivar.

MATERIAL AND METHODS

The study was conducted at the Field Horticultural Department, Gaziosmanpasa University, Faculty of Agriculture, Tokat, Turkey (40°13′- 40°22′ N, 36°1′- 36°40′ E, altitude 525 m) in the 2004. Some climatic data for the research area are given Table 1. Soil samples were collected from 0-20 cm depth. Organic matter was determined by Wajkley-Black method as suggested by Black[10]. The experimental soil is slightly alkaline (pH 7.79), medium in calcium carbonate (11.9%), poor in P (2.06 mg P_2O_5 100 g^{-1} soil), rich in K (28.7 mg K_2O 100 g^{-1} soil) and poor in organic matter (1.47 %). The characteristic of experimental SM is alkaline (8.21), rich N content (9.34 %), poor in P content (%1.79), rich K content (84.47 mg K_2O 100 g^{-1} soil) and rich in organic matter (55%).

A randomized complete block design with three replications was adapted four N treatments: 1) 0 N as a control (NO); 2) 56 kg.ha^{-1} applied as a single spring application in late March (N1); 3) 112 kg.ha^{-1} as a single spring application in late March (N2); and 4) 112 kg.ha^{-1} applied in split application, with equal portions in late March and late June (N4). Ammonium nitrat was the N source (26% N) applied near the base of the canes

in 2004. Otherwise applied at 30 ton.ha^{-1} (SM_1) or 40 ton.ha^{-1} (SM_2) dry sheep manure (before planting in late winter) in single applications. The seedlings of red raspberry cv. Cola II (a year-old) were planted on March, 2004.

The full samples used for analysis for fresh berry were dried and grinded. Dry samples were reweighted to calculate total solids and then were used to determine berry N, P and K content. N was determined by the Kjeldahl method[11]. Crude protein(CP) contents (N x 5.70). Phosphorus (P) was determined according to Olssen and Sommers[12] and potassium (K) was determined by a photometric method[11].

Soluble solid content (SSC) was determined at 20 °C with a hand -held refractometer (Hand Sugar Refractometer, model WYT-1). Results were exspressed in terms of berry weight (%). The pH was measured in the non-diluted of juice, using a pH meter. Titratable acidity (TA) was expressed as percentage of citric acid determined with the aliquots of 5-10 ml berry juices diluted with 40-50 ml of pure water. Prepared juice was titrated with 0.1 N NaOH , up to pH of 8.1. This potentiometer titration was performed with a pH combined electrode HI 2031 B/HI 2020 S[5,13].

Data were analysed with analysis of varience (Anova) procedures using the SAS Statistical Soft-ware Package[14]. The means for N rates, and organic manures applications were grouped based on LSD test. Results in all statistical calculations were considered to be significant for *P*-values < 0.05.

Table 1 . Climatic data for the experimental area in the year 2004* in Tokat-Turkey

Month	Temperature (°C) Min.	Max.	Mean	Rainfall (mm)
April	- 8.3	30.5	11.3	32.0
May	0.7	30.1	14.9	48.0
June	6.5	32.4	18.7	27.2
July	7.0	36.2	20.6	0.4
August	9.9	36.4	21.9	4.8
September	1.1	33.3	16.8	0.0
Mean Total	*16.9*	*198.9*	*104.2*	*112.4*

*:The meteorological station of general directorate of ural services (the elevation is 585 m)

RESULTS AND DISCUSSION

The effect of N rates on titratable acidity, pH, berry P and K contents were significant. Although no significant difference were observed among the application methods, the effect of half/spring of N rate on berry K and P content were significant. No significant difference observed among the the application methods. No similar results were reported for pH and TA, levels of N and K applied were 0, 67 and 135 kg.ha^{-1} by Martin and Nelson[3] .

Among N and SM treatments, no significant effect was detected for SSC (means ranged from 12.60% to 13.50%), total solids (means ranged from 21.82% to 30.33%) and seed ratio (means ranged from 5.57 % to 6.64%). Similar results were reported for SSC in arapaho cv. Blackberry by Alleyne and Clark[5].

Timing of N and SM application did not affect berry composition (Except for TA, pH, P and K content). N content which Cola II berry was not affected by N and SM applications, thus berry crude protein was affected significantly. Similar results were reported by Clark and Watson[15] and Naraguma et al.[16]. SM_1 application affected berry P and K contents. Results suggested that rates of 56 kg N.ha^{-1} or 30 ton SM.ha^{-1} may be used, in cv. 'Cola II' red raspberry growing, in Tokat conditions.

Good nitrogen management in raspberries makes good agronomic and economic sense. Application of little nitrogen in lower amounts can result in reduced yield, reduced crop vigour and possibly reduce the life expectancy of the crop stand. However, applying too much nitrogen in excess amounts which means unnecessary input costs, may result in increased disease incidince and reduced crop quality. High nitrogen levels may also interfere with berry set and dormancy. Over application of nitrogen can also impact the environment. In most cases important amount of nitrogen remaining in the soil in the fall is washed out of the root zone over the fall and winter[17].

Table 2. Effect of rate and timing of application of N fertilizer and organic manure on some berry chemical characteristics of Cola II Red Raspberry cultuvar in Tokat, Turkey

Variable	Total solid (%)	Total soluble solid (%)	Total Acidity (%)*	pH*
N-application[x]				
N 0-None(Control)	24.61	12.75	2.54 a	3.61b
N 1- Half/spring	30.33	13.10	2.15ab	3.72a
N 2-Full/spring	21.82	12.60 1	.88c 3	.61b
N 3-Full/split	25.29	12.25 2	.55a 3	.58b
Organic manure[y]				
OM1$_1$(full/winter)	23.26	13.13	1.97c	3.65ab
OM2$_2$(full/winter)	23.77	13.50 1	.95c 3	.62b

*Means with same letter are not different at the p=0.05(*) and p=0.01(**)
[x] Half application: 56 kg.ha^{-1}, full application : 112 kg.ha^{-1}
[y] SM_1 : 30 ton.ha^{-1}, SM_2 : 40 ton.ha^{-1}

Table 3. Effect of rate and timing of application of N fertilizer and organic manure on some berry chemical characteristics of Cola II Red Raspberry cultuvar in Tokat, Turkey

Variable	N content (%)	P content (%)*	K content (%)*	Crude protein (%)
N-application[x]				
N 0-None(Control)	0.95	0.26 a	0.0016 a	5.41
N 1- Half/spring	0.92 0	.17 b	0.0010 b	5.28
N 2-Full/spring	0.94 0	.23 a	0.0016 a	5.33
N 3-Full/split	0.86 0	.25 a	0.0014 a	4.92
Organic manure[y]				
OM1$_1$(full/winter)	0.94	0.24 a	0.0015 a	5.36
OM2$_2$(full/winter)	0.87 0	.24 a	0.0016 a	4.94

*Means with same letter are not different at the p=0.05(*) and p=0.01(**)
[x] Half application: 56 kg.ha^{-1}, full application : 112 kg.ha^{-1}
[y] SM_1 : 30 ton.ha^{-1}, SM_2 : 40 ton.ha^{-1}

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