

Title: Seasonal Variation in blackberry nutrient concentration of primocane and florican leaves in Prime-Ark 45 and Traveler in double and single cropping systems

Name, Mailing and Email Address of Principal Investigator(s):

Principal Investigator:

Dr. Gina E. Fernandez
Department of Horticultural Science
North Carolina State University
Raleigh NC 27695
Gina_Fernandez@ncsu.edu

Other NCSU personnel

Karen Blaedow
Horticulture Agent
Henderson County Center
100 Jackson Park Rd.
Hendersonville, NC 28792
karen_blaedow@ncsu.edu

Daniel L. Shires
Area Agriculture Extension Agent
Cleveland and Gaston County
North Carolina Cooperative Extension Service
130 South Post Road Suite 1
Shelby, NC 28152
704-480-6484 Fax
<http://cleveland.ces.ncsu.edu>

Other agency personnel:

Kristin A. Hicks PhD.
Section Chief
Plant Tissue, Waste & Compost, Solutions and Soilless Media Testing
Agronomic Division, NCDA&CS
4300 Reedy Creek Rd.
Raleigh, NC 27607-6465
Kristin.Hicks@ncagr.gov

Steve Dillon
Regional Agronomist Region 14
NCDA&CS Agronomic Division
(980)241-0101
steve.dillon@ncagr.gov

Out of state investigators:

Dr. Amanda McWhirt

Department of Horticulture

University of Arkansas

Little Rock, AR

Public Abstract:

In the past few years, growers in the southern US have planted an increasing number of acres of primocane-fruiting blackberry (e.g. APF-45 and Traveler). This new type of blackberry enables growers to produce fruit only the first year then mow canes (single crop) or to produce fruit on first year canes, and allow those canes to produce a crop in the second year in the spring on the floricanes, and another crop in the fall on the primocanes (double cropping). These new cropping systems demand different fertility needs than what has been done with the *floricane-fruiting only* cropping system. However, there is no information on season long nutrient levels for primocane-fruiting types of blackberries cropping systems for this region. This study looked at nutrient levels in single and double cropping primocane-fruiting blackberries over two seasons at of the two most widely planted primocane-fruiting blackberries APF-45 and Traveler.

Introduction:

In 2005, the first primocane-fruiting blackberries were released from the University of Arkansas, Prime-Jim® and Prime-Jan®. These early cultivars were released to give growers some time to learn how to manage the plants mostly for production of a crop on both primocanes and floricanes. More recently, highly productive cultivars from the Prime-Ark® series have been released (e.g. APF-45 and Traveler) and many growers in the southern US have started to grow more of them on a commercial scale. Growers can opt to produce fruit only the first year, then mow canes (single crop) or to produce fruit on first year canes, and allow those canes to produce a crop in the second year in the spring on the floricanes, and another crop in the fall on the primocanes (double cropping). These new cropping systems demand different fertility needs than what has been done with the *floricane-fruiting only* cropping system. However, there is no information on season long nutrient levels for primocane-fruiting types of blackberries in single or double cropping systems in this region. Growers have expressed concern that they do not have adequate information on how to fertilize these new types of blackberries and their cropping systems.

The objective of this outreach effort was to develop baseline nutrient sufficiency levels in primocane and floricane double and single cropping systems of Prime-Ark® 45 and Prime-Ark® Traveler blackberry. Currently, plant tissue sufficiency ranges are based on floricane-fruiting varieties. It has not been determined if these ranges adequately represent sufficient nutrient levels at different growth stages for primocane-fruiting varieties in single or double cropping systems. Sufficiency ranges currently used by NCDA&CS are as follows:

	%			ppm
N	2.4-3		Fe	50-300
P	0.15-0.6		Mn	50-250
K	1-2		Zn	20-70
Ca	0.5-1		Cu	7-15
Mg	0.3-0.5		B	30-50
S	0.13-0.6		Mo	0.04-2

Description of Outreach Activity:

In 2018-19, researchers from NC State University and the North Carolina Department of Agriculture and Consumer Services (NCDA&CS), conducted a season long study to gather baseline nutritional information on single and double cropping Traveler and Prime-Ark 45 blackberries at two on-farm sites in North Carolina. The same two farms participated in this study for two year and were sampled from the same fields and rows. Farm 1 in Shelby NC had 4 replicated plots (rows) of ‘APF-45’ and Farm 2 in Hendersonville, NC had 2 replicated plots (rows) of ‘Traveler’. Both locations had single and double cropping fields. Leaf samples were collected every 2-3 weeks from April 15-Oct 15 (24 weeks) for a total of 8 sample dates by Steve Dillon from NCDA&CS. In single cropping fields, twenty most recently mature leaves (MRML) were collected from each plot. In double cropping fields, MRML were collected from primocanes and from floricanes (mid section of a fruiting lateral). Samples were analyzed by the NCDA&CS Agronomic Division for N, P, K, Ca, Mg, S, Fe, Mn, Zn and B.

At approximately the same time of leaf harvest, seasonal phenology of the plants (e.g. primocane emergence, flowering, fruiting etc.) and important phenological dates (bud break, peak bloom, peak fruiting etc. and Brix levels) were recorded and photographed by local county Extension agents Karen Blaedow and Daniel Shires.

Results or Outcome:

Results are presented below for the 2019 season. Nitrogen levels in leaf tissue were above the sufficiency level in both varieties, all sampling dates and all cropping systems with the exception of the late June, mid-July sampling dates (fruiting) for single-cropped Prime-Ark 45 (Fig. 1a).

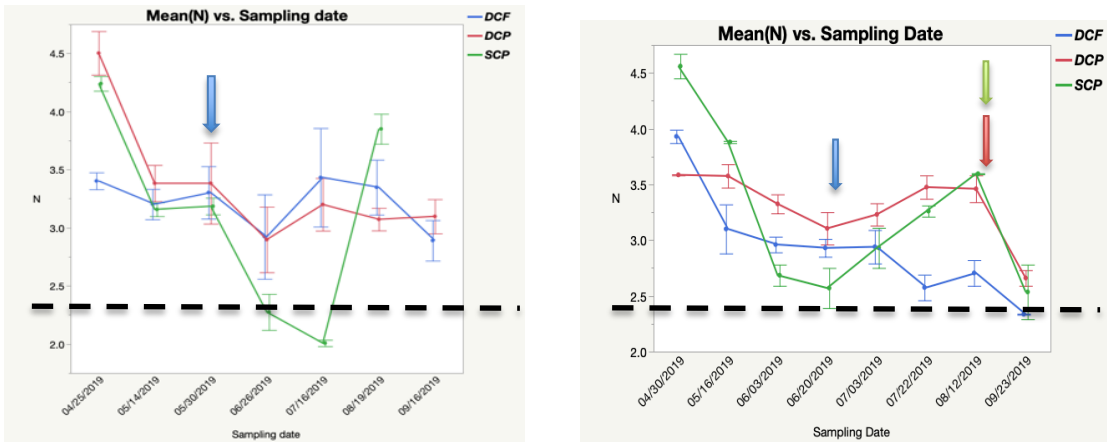


Figure 1. Mean N in leaf tissue through the season of APF-45 (A on left) and Traveler (B on right). N is expressed as a percent. Dashed line indicates the sufficiency level. Double Crop Floricane (DCF), Double Crop Primocane (DCP), Single Crop Primocane (SCP). Colored arrows indicate first harvest period for each cropping system, colors same as crop system.

As with N, P levels were below the sufficiency level in single-cropped Prime-Ark 45 during fruiting but rapidly recovered (Fig. 2a). P levels were also below the sufficiency level in Traveler in the double-cropped floricane leaves at fruiting. P is considered to be mobile in leaf tissue, meaning that it can be re-allocated within the plant from inactive areas (older leaves such as floricanes) to actively growing leaves (primocanes) or to reproductive parts. Note that P in the corresponding double-cropped primocanes increased at the same time as it decreased in the floricanes. This is a normal process and should not indicate a fertility problem.

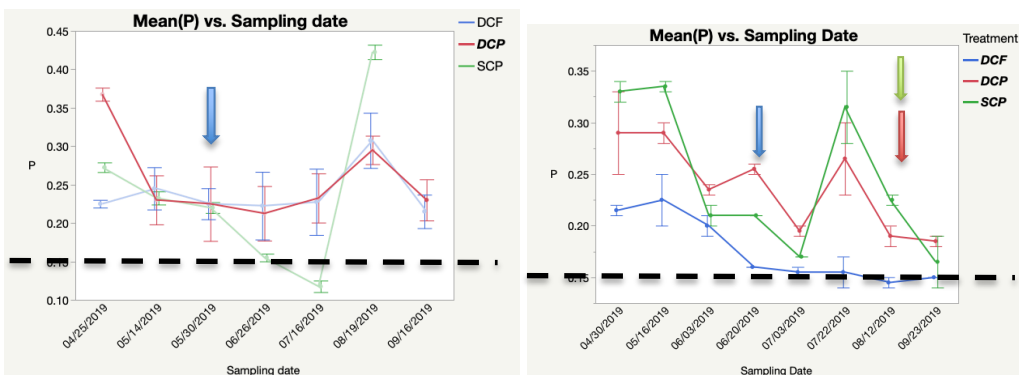


Figure 2. Mean P in the leaf tissue through the season of APF-45 (A on left) and Traveler (B on right). P is expressed as a percent. Dashed line indicates the sufficiency level. Double Crop Floricane (DCF), Double Crop Primocane (DCP), Single Crop Primocane (SCP). Colored arrows indicate first harvest period for each cropping system, colors same as crop system.

K is a mobile nutrient that is essential for good quality fruit and flavor. K levels were generally above sufficiency level regardless of variety, cropping system or growth stage. K was below sufficiency in Traveler double-cropped primocanes at the end of the season but is normal for K to drop in the leaves during heavy fruiting (mobility) and should not indicate a fertility concern (Fig. 3b).

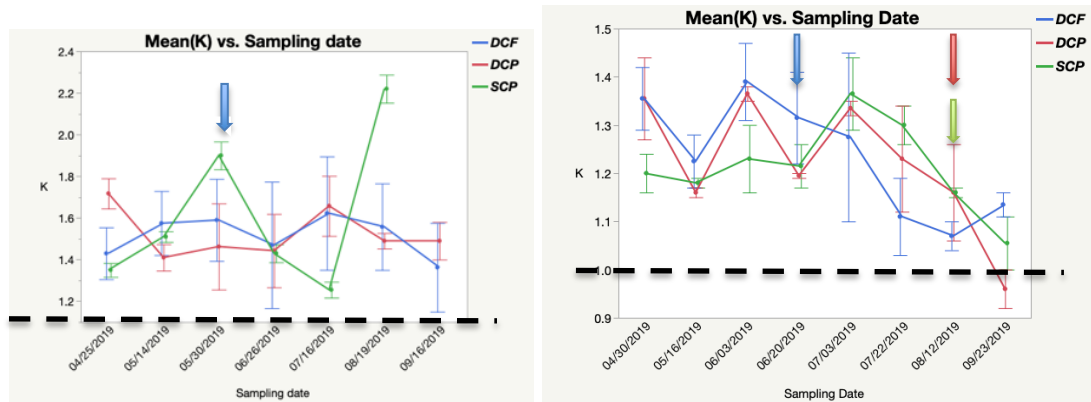


Figure 3. Mean K in the leaf tissue through the season of APF-45 (A on left) and Traveler (B on right). K is expressed as %. Dashed line indicates the sufficiency level. Double Crop Floricane (DCF), Double Crop Primocane (DCP), Single Crop Primocane (SCP). Colored arrows indicate first harvest period for each cropping system, colors same as crop system.

Calcium levels in the leaf tissue were below the sufficiency level for most sampling dates in both single and double-cropped primocanes in both Traveler and Prime-Ark 45. Ca was much higher in the floricanes than in the primocanes under all conditions. Ca is a highly immobile nutrient that moves within the plant only by root uptake and xylem flow, meaning that Ca deficiency is highly susceptible to uneven watering conditions or uneven nutrient supply. Whether Ca supply was insufficient based on primocane leaves or whether tissue sufficiency levels should be adjusted downward for primocane leaves merits further study.

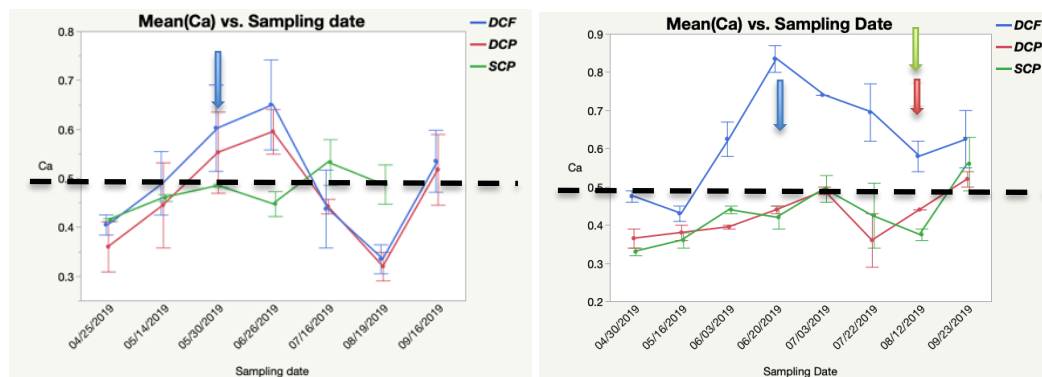


Figure 4. Mean Ca in the leaf tissue through the season of APF-45 (A on left) and Traveler (B on right). Ca is expressed as a %. Dashed line indicates the sufficiency level. Double Crop Floricane (DCF), Double Crop Primocane (DCP), Single Crop Primocane (SCP). Colored arrows indicate first harvest period for each cropping system, colors same as crop system.

Magnesium levels were below sufficiency for multiple sampling dates, both varieties and multiple cropping systems but especially low in the Prime-Ark 45, single-cropped system at fruiting (July). Adequate Mg is essential for supporting photosynthesis. An evaluation of Mg fertility recommendations in blackberry merits further study.

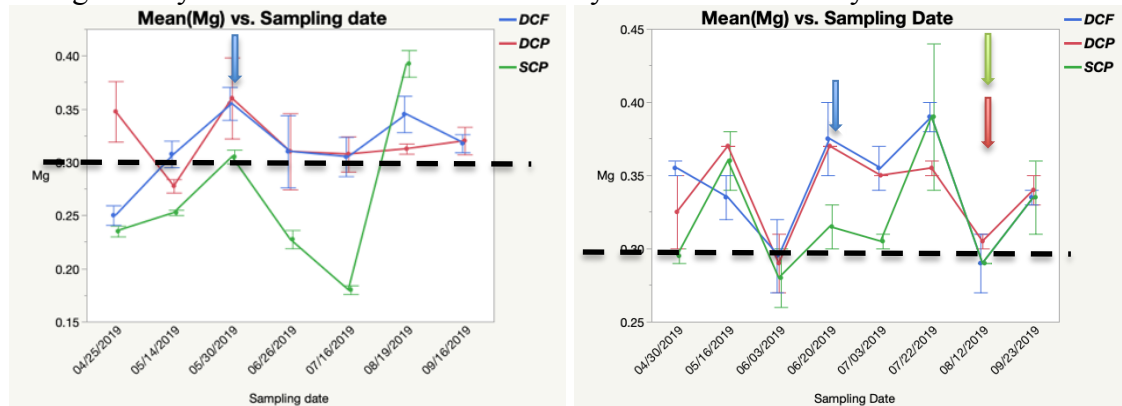


Figure 5. Mean Mg in leaf tissue through the season of APF-45 (A on left) and Traveler (B on right). Mg is expressed as %. Dashed line indicates the sufficiency level. Double Crop Floricane (DCF), Double Crop Primocane (DCP), Single Crop Primocane (SCP). Colored arrows indicate first harvest period for each cropping system, colors same as crop system.

Boron was sufficient in Prime-Ark 45 at all sampling dates and cropping systems except at early growth in the single-cropped system. Conversely, B was below sufficiency in the primocanes of Traveler at most sampling dates. B is essential for flower formation and fruit quality and blackberries need adequate levels of B in actively growing areas (e.g. primocane leaves, flowers) in order to produce high levels of quality fruit. B in recommendations in primocane-fruited blackberry require further study.

In addition, B levels in floricanes were consistently higher than in the corresponding primocanes. B fertility management requires an understanding of B mobility in the crop. B differs from many other nutrients in that it is mobile in some crops and immobile in other crops. For example, B is mobile in brassicas and most fruit trees and immobile in strawberry and most field crops. Our preliminary data indicates that B is immobile in blackberry which is a new finding in the scientific literature and which plays an important role in determining the most effective way to manage B fertility in this crop.

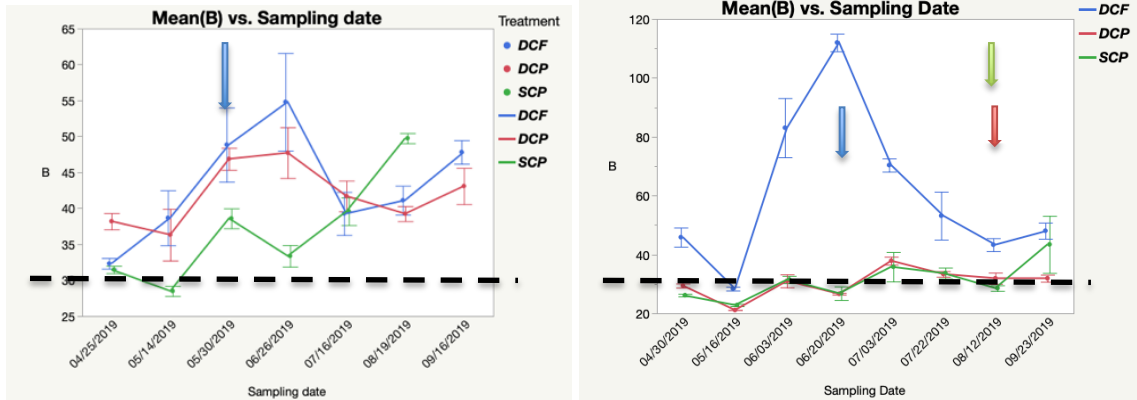


Figure 6. Mean B in leaf tissue through the season of APF-45 (A on left) and Traveler (B on right). B is expressed in ppm. Dashed line indicates the sufficiency level. Double Crop Floricane (DCF), Double Crop Primocane (DCP), Single Crop Primocane (SCP). Colored arrows indicate first harvest period for each cropping system, colors same as crop system.

Tissue levels of S, Fe, Mn, Cu and Zn generally fell within the established sufficiency ranges for both Traveler and Prime-Ark 45 throughout the growing season (data not shown). S, Fe and Zn levels were below sufficiency during fruiting (July) for the single cropping system in Prime-Ark 45 but not in Traveler. This trend was noted for other nutrients as well and many be due to heavy fruit load or extremely dry conditions at that time.

The total soluble solids or Brix levels were measure during the harvest season on mature berries. For Traveler, we found the lowest levels 6.7, on 9 Aug., this was the date of the first SC harvest. The highest Brix were recorded on 16 September which was the last SC harvest.

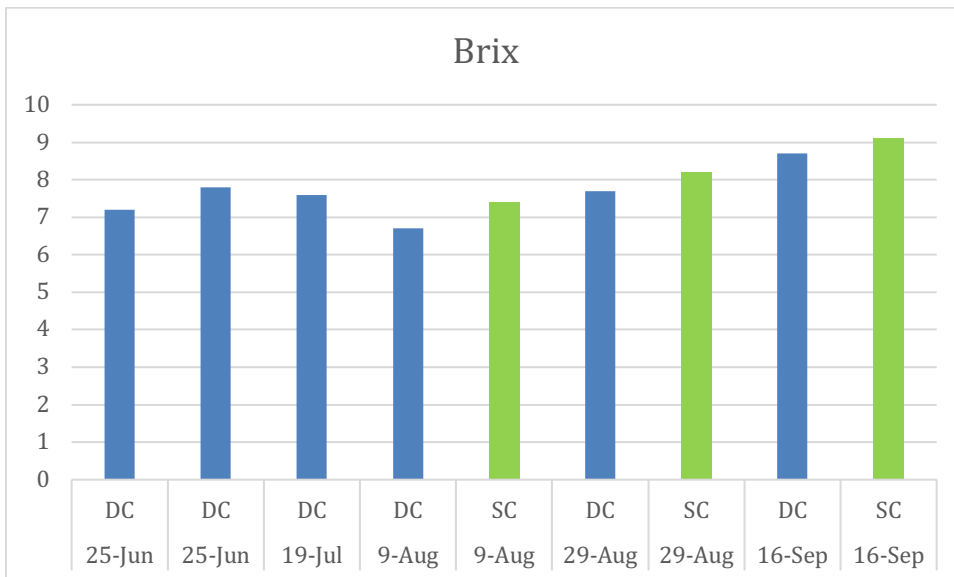


Figure 5. Brix levels through the season of Traveler Double (DC) and Single Crop (SC) plots.