

Potassium Uptake by Kiwi Orchards in Shaanxi

By Yan'an Tong, Wang Jian, and Ma Wenjuan

Potassium concentration and accumulation in kiwi fruit trees showed that fall accumulated K was used to meet demand during fruit expansion in early July of the next year. When fruit production was 40 t/ha, the total K uptake was 170 kg/ha. Of that, 43 kg/ha was accumulated from September to the following May, and 125 kg/ha was taken up during the fruit formation period between May and September.

Potassium is usually regarded as a “quality element” in fruit production (Fvalli, 1998). More specifically, the cycling and recycling of K in the plant plays an important role in maintaining cation-anion balance (Engels et al., 1996), providing dynamics for solute flow in the xylem and phloem (Mengel et al., 1973; Marschner, 1995; Hayashi et al., 1990; Mengel et al., 1977), a feedback signal regulating K uptake by the root (Drew et al., 1990; Engle et al., 1992), and provides the K required for proper functioning of phloem loading (Mengel et al., 1977; Huber et al., 1981; Giaquinta et al., 1979; Lohaus et al., 1995). Although much attention has been paid to the cycling and recycling mechanism of K in plants, information on biomass and K accumulation are still lacking due to the limited research in this area.

Latest statistics put the total area planted to kiwi fruit in China at 55,000 ha in 2005, while total production was 457,000 metric tons (t). In Shaanxi Province, 16,000 ha of kiwi is currently planted, representing 30% of planted area in China. This region produces 240,000 t of fruit, accounting for 53% of total production in China. Even though kiwi fruit orchards are located in loess soil areas rich in K (Institute of Soil Science, 1978), application of K fertilizer can still improve the yield and quality. The objective of this study was to determine the principles of K uptake by kiwi trees and provide guidelines for K application at the right amounts and the right time intervals.

A field trial was conducted in Maitun Village, Zhouzhi County, the main kiwi fruit production area in Shaanxi. The annual mean temperature is 13.2 °C, annual precipitation is 660 mm, and annual sunshine is 1,870 hrs. The orchard site was a 10-year old kiwi orchard (Qinmei variety). The trial was carried out during 2005 and 2006. Three trees were selected each time for sampling at six different stages. Sampling began on March 28 (sprouting and foliage growing), May 18 (young fruit), July 9 (fruit expansion), September 8 (fruit maturity), November 6 (defoliation) in 2005, and on January 11 in 2006 (dormancy). Samples of fruit, leaves, new tops, branches, trunks, and roots were collected separately at each sampling time. Root samples were collected within a radius of 100 cm around the trunk and from five successive 20 cm layers down to the 100 cm depth.

Results indicated that the biomass of kiwi fruit trees increased slowly at earlier growth stages from March 28 to May 18, then faster from May 18 to July 9, reaching the peak on September 8 (Figure 1). The root biomass increased slowly and steadily during this period.

Abbreviations and notes for this article: K = potassium.



Potassium accumulation in kiwi fruit trees followed similar patterns observed for biomass accumulation (Figure 2). Of the total K accumulated, 74% was accumulated during the fruit growing period between May 18 to September 8. Potassium removed in harvested fruit and fallen leaves represented 61% and 22% of total K accumulation, respectively. Potassium

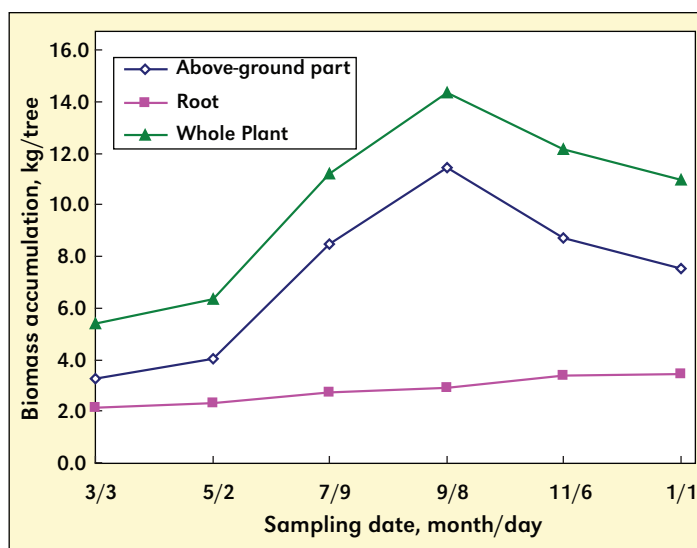


Figure 1. Annual changes of biomass in kiwi fruit trees, Zhouzhi County, Shaanxi.

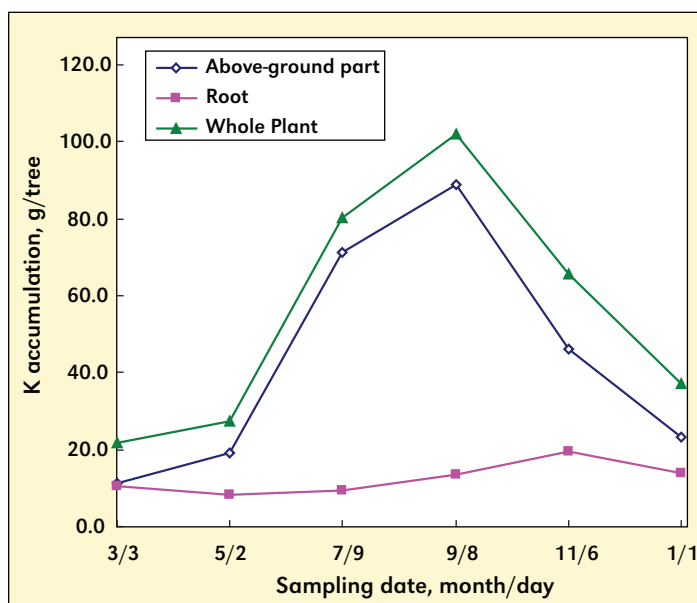


Figure 2. Annual changes of K accumulation in kiwi fruit trees, Zhouzhi County, Shaanxi.



Researchers sample below-ground plant parts for nutrient composition.

accumulation in roots changed only slightly over the studied period.

Potassium concentrations in roots decreased slightly from March 28 to July 9, increased from July 9 to November 6, and then decreased after November 6. Potassium concentration in the stem was similar to that in the root. The leaves had the highest K concentration on May 18 and dropped to the lowest level in July 9. Potassium concentration in fruit declined from July 9 to September 8 (**Figure 3**).

Potassium within the xylem and stem or root cortex also decreased during the earlier growing stages (**Figure 4**). Potassium concentrations in xylem were much lower than those in the cortex. Potassium in the cortex dropped to its lowest levels on May 18, and then it increased and reached its highest level on November 6. As cited earlier, this cycling and recycling of K provided the sieve tubes with K nutrition necessary for functioning of phloem loading, so these changes of K concentrations may be the result of fruit growth and carbohydrate transportation in phloem. This trend in K concentrations is similar to

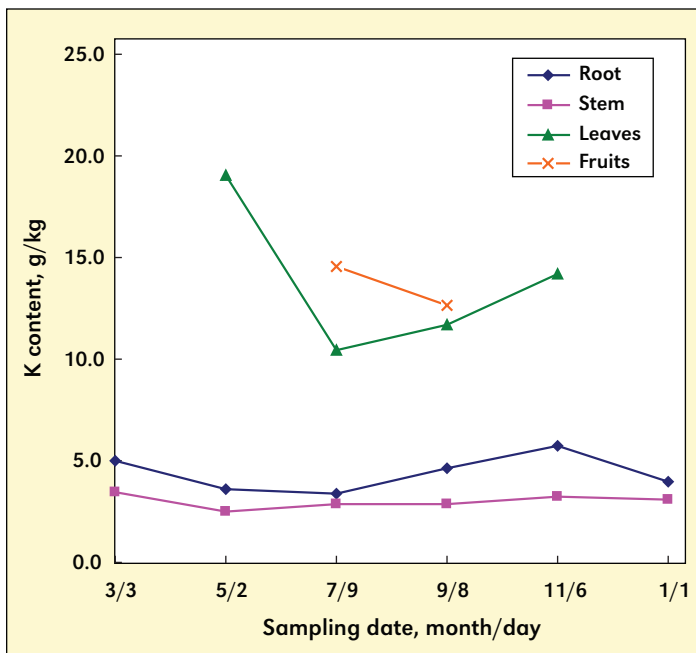


Figure 3. Dynamic changes of K concentration in root, stem, fruits and leaves of kiwi fruit tree, Zhouzhi County, Shaanxi.



Researchers sample above-ground plant parts for nutrient composition.

results obtained by Qin (2004). Potassium concentrations in xylem changed only slightly during the period studied.

The period when fruit trees had the highest demand for K was between mid-May and early July (**Table 1**). Net K accumulation during this growth interval was 89 kg/ha. From May to July, K accumulation in roots, stems, and fruits increased by 1 kg/ha, 6 kg/ha, and 87 kg/ha, respectively. Leaves showed a net loss of 5 kg/ha during this time frame. Therefore, developing fruits received 98% of accumulated K from May to July.

By harvest time, on September 8, another 36 kg/ha distributed similarly between the roots (7 kg/ha), stems (7 kg/ha), and leaves (5 kg/ha), while 17 kg/ha was stored within the fruits.

Total annual net K accumulation in this established kiwi fruit tree orchard, with a yield of 40 t/ha, was 170 kg K/ha.

This research found two distinct periods when trees required more K. The first period was after fruit harvest in the

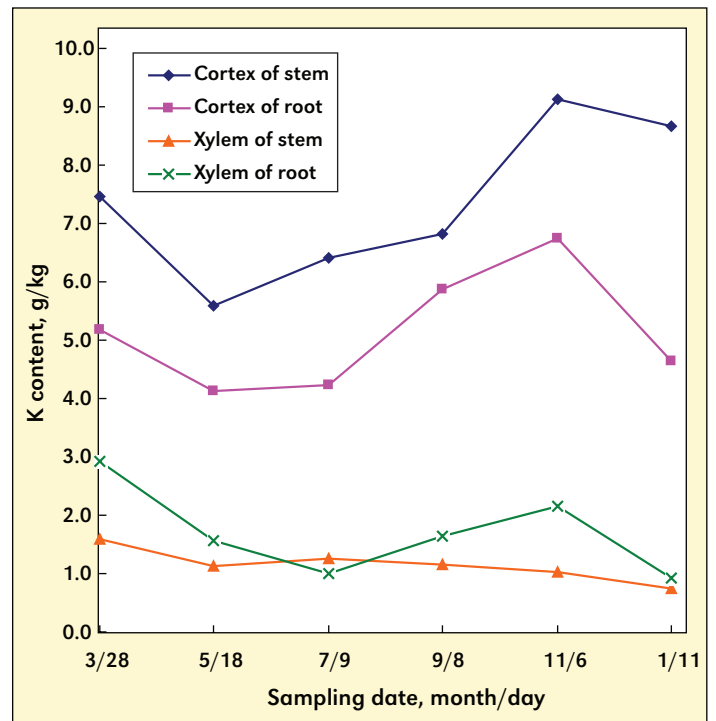


Figure 4. Dynamic changes of K concentration in xylem and cortex of kiwi fruit tree, Zhouzhi County, Shaanxi.