ALBERTA

Weeds Dine Out on Nitrogen and Phosphorus

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Cultural weed control methods are becoming more important where efficacious herbicides are limited or herbicide resistance has become prevalent. Manipulating crop fertilization may be one method of reducing weed interference in crops. Nitrogen (N) fertilizer can break seed dormancy of certain weed species and thus may directly affect weed infestation densities. Added N can markedly alter crop-weed competitive interactions. Depending on the species and density, N fertilizer can increase the competitive ability of weeds more than that of the crop.

> Weeds, like crops, respond positively to increased soil fertility. In fact, a number of common weed species show a greater response to fertilization than spring wheat or canola.

Research indicates that fertilizer placement can alter weed competition with crops. Nitrogen fertilizer placement in narrow in-soil bands has been found to reduce the competitive ability of downy brome (*Bromus tectorum*), foxtail barley (*Hordeum jubatum*), and wild oat (*Avena fatua*) more than surface broadcast. However results vary, and other studies report that N placement had little effect on the competitive ability of downy brome or green foxtail (*Setaria viridis*). Despite extensive knowledge of how crops respond to soil fertility, little information is available on how weeds respond to fertility levels. Since N and phosphorus (P) are the major nutrients applied to crops in western Canada, we conducted a study to determine the growth response of common weed species to increasing amounts of N and P.

Weed and crop species were grown in a nutrient deficient sandy loam soil (less than 15 lb/A of available N and P) under controlled conditions in a greenhouse. Twenty-three weed species were evaluated, but only data on green foxtail, wild oat, Russian thistle (*Salsola iberica*), stork's-bill (*Erodium cicutarium*), cleavers (*Galium aparine*), redroot pigweed (*Amaranthus retroflexus*), wild mustard (*Sinapis arvensis*), kochia (*Kochia scoparia*), round-leaved mallow (*Malva pusilla*), and wild buckwheat (*Polygonum convovulus*) are presented. The crops grown were spring wheat (*Triticum aestivum*) and canola (*Brassica napus*). Five plants of each

Response of hairy nightshade to increasing soil P levels is shown in this greenhouse photo. Rates are equivalent to parts per million (ppm).

species were grown in 6-in. diameter pots. Nutrients were applied at rates approximating field rates. Nitrogen was applied as ammonium nitrate (NH_4NO_3) and P as potassium phosphate (K_2HPO_4). All treatments were replicated four times. Other nutrients were maintained at levels adequate for healthy plant growth, using potassium sulfate (K_2SO_4). Shoot dry weights of each species were determined after six weeks of growth. Separate experiments were conducted for each nutrient, and the study was repeated.

TABLE 1. Shoot biomass response to increasing amounts of N taken six weeks after emergence.

Species	Nitrogen, ppm 40	80	120	180	240
	% of biomass at 0 N rate				
Wheat	243	332	330	339	370
Canola	214	320	378	440	474
Russian thistle	141	182	165	149	158
Stork's-bill	232	314	336	347	350
Cleavers	265	368	390	368	371
Wild oats	349	456	413	466	456
Redroot pigweed	290	407	610	662	692
Wild mustard	317	517	644	733	800

TABLE 2. Shoot biomass response to increasing amounts of P taken six weeks after emergence.

Species	Phosphorus, ppm 5	10	20	40	60
	% of biomass at 0 P rate				
Wheat	169	234	261	293	308
Canola	177	240	285	311	348
Kochia	185	218	232	229	273
Wild oats	310	480	608	536	550
Green foxtail	433	570	717	977	820
Round-leaved mallow	279	472	580	674	624
Wild buckwheat	383	561	651	782	796
Stork's-bill	452	690	784	949	950

In this nutrient deficient soil, wheat and canola shoot biomass increased markedly (300 to 400 percent) to added N and P (**Tables 1** and **2**). Weed biomass also increased with added N and P, although the magnitude of the biomass increases varied considerably among the weed species.

Russian thistle biomass responded less than wheat or canola to added N (**Table 1**). The growth responses of stork's-bill, cleavers, and wild oats were of similar magnitude to those of the two crops. However, redroot pigweed and wild mustard biomass responded more to added N than either crop.

Kochia was one of the few species that responded less than wheat or canola to added P (**Table 2**). Wild buckwheat, green foxtail, and stork's-bill growth increased up to three-fold more than either canola or wheat, indicating the importance of P nutrition to the growth and competitive ability of many weed species.

It has often been reported that weeds thrive on soils with low fertility. Our study indicates that this is likely not the case. In fact many of the common agricultural weeds found in western Canada benefit from efforts to improve soil fertility. The biomass of many weed species increased considerably more than wheat or canola to added N or P.

This study also revealed that weed species varied tremendously in their response to added nutrients. Some species exhibited a strong growth response to either N or P, while others responded strongly to both nutrients. Surprisingly, biomass of many weeds increased more with added P than with added N.

One of the questions we wanted to answer with this study was if certain weed species were in fact luxury consumers of either N or P. At the highest N rate, Russian thistle biomass increased only one and a half-fold, but its shoot N concentration increased three-fold (data not shown). Growing in the field, Russian thistle would reduce N available to the crop by more than might be predicted from its growth response alone.

Fertilizer is a major cost to crop production. Efficient utilization of fertilizer nutrients requires reducing losses to the environment and to weeds. Weeds, like crops, respond positively to increased soil fertility. In a worst-case scenario, crop yields may actually decrease as fertilizer rates increase if weeds have access to the added fertility.

Further research will be conducted to develop agronomic practices that simultaneously reduce weed populations and result in optimal crop yields. A greater understanding of how N and P placement affects crop-weed competition should lead to a clearer interpretation of why differences occurred among previous studies. In addition, it could lead to the development of fertilization strategies, such as timing and placement of nutrients, that reduce weed interference with crops. BC

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*P and K Nutrition of Pistachio Trees...**(continued from page 19)*

Nutrient Removal

Almost all of the K taken up by the on-year trees was subsequently removed in fruit and abscised leaves during late summer and fall (**Figure 2**). This indicates that little K was stored over winter and that substantial quantities of K must be present in the soil during heavy cropping years to avoid K deficiency. In contrast, P removal was double that of P uptake during the on-year, indicating that much of the P demand was met by redistribution from storage. Phosphorus, therefore, can be stored in perennial tree parts and used the following year, but little K appears to be stored and used in the subsequent year.

The pronounced effect of alternate fruit bearing on tree P and K demand and capacity for uptake has important implications for fertilizer management. The greatest amount of soil P and K uptake occurred during the nut fill period in on-year trees. Thus, P and K must be available in the soil at this time. How much P and K to apply, however, depends on management considerations such as method of application, soil test values, and tree density, as well as tree physiological considerations such as nutrient status and potential crop yield.

Summary

We examined interrelationships among crop load, P and K uptake, and root growth in mature pistachio trees that characteristically bear heavy (on-year) nut crops in alternate years. Uptake and partitioning of P and K among tree parts were determined during nut fill (late May to early September). Although root growth was reduced during nut fill in on-year trees compared with off-year trees, there was no relationship between root growth and the uptake of P or K from the soil. Our data support the hypothesis that sink demand rather than root growth regulates the uptake of P and K in pistachio trees. BC

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