PHOSPHORUS FOR BLOOMING PLANTS

Mitchell, C.C.[1], Pinkston, C.B.[2], and Wheeler, E.J.[2]
[1] Extension Agronomist-Soils, Dept. Agronomy & Soils, Auburn University, AL 36849
[2] Regional Extension Agent, Alabama Coop. Ext. System, Cullman County, Cullman, AL 35055
[3] Urban Regional Extension Agent, Alabama Coop. Ext. System , Marshall County, Guntersville, AL 35976

BACKGROUND

Specialty fertilizers are often promoted using the theory that high phosphorus (P or P_2O_5) is necessary to promote desirable blooms in plants. Fertilizers sold in garden centers as "bloom boosters", "super bloom", or "for flowering plants" always contain a higher percentage of P_2O_5 than any other primary nutrient. We know that P is involved in the biochemical pathway of energy transfer within a plant and that the process of blooming requires a lot of energy (Tisdale, et al., 1985). We also know that high N promotes vegetative growth. Excessive N may produce vegetative growth at the expense of reproduction (e.g. blooming). Plants can only use a limited amount of any nutrient. Soil samples tested by the Auburn University Soil Testing Laboratory in 2004 and 2005 from Cullman County found that 13 percent tested "extremely high" in P, 34 percent tested "very high" in P, and 21 percent tested "high" in P. In adjacent Marshall County, the values were 7 percent extremely high, 30 percent very high, and 19 percent high. High soil test P is defined as that level which is adequate for growth and production of most crops (25 mg P/kg using the Mehlich-1 extractant for loamy soils). Very high is 2 times this value and extremely high is 5 times this value (Adams et al., 1994).

Gardeners are often confused when their soil test report recommends zero P yet all the products on the market for blooming plants contain high P. Therefore, they may ask, "If a soil is already testing high or very high in P, will additional P fertilizer actually stimulate blooming?" This question is particularly relevant because of the environmental concerns with excessive P runoff into lakes, streams and waterways.

OBJECTIVES

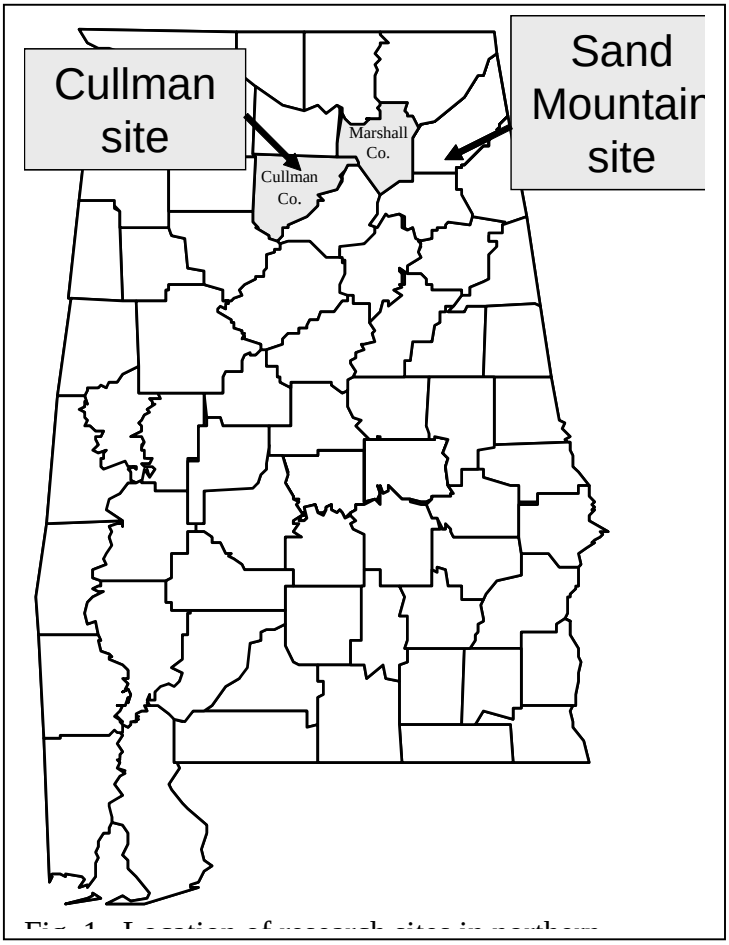
1) Determine if additional P in a fertilizer will actually stimulate blooming among selective annual blooming plants when grown in a soil testing high in P.
2) Engage Master Gardeners in the practice of applied, small plot research.

PROCEDURES

Master Gardener volunteers in Cullman and Marshall Counties agreed to do most of the field work and data collection for experiments to address objective 1. Uniform sites existed on the North Alabama Horticulture Research Center at Cullman, AL, and at the Sand Mountain Research & Extension Center in Crossville, AL, that tested very high in P (Fig. 1). The Cullman site is a Hartsells loam and the Sand Mountain site is a Hartsells fine sandy loam (fine-loamy, siliceous, thermic Typic Hapludults). Both sites had a history of intensive fertilization and crop production.

Sites were prepared with a spader tractor implement (Cullman) or roto-tiller (Sand Mt.). Fertilizer treatments listed in Table 1 were hand applied prior to planting in April and again once during the growing season. Treatments were arranged in a randomized block design with 4 replications. Plot size was 5 feet x 5 feet with 5 feet between blocks. Treatments (Table 1) were

selected to represent N rates from 0 to 120 pounds N per acre and P rates from 0 to 120 pounds P_2O_5 per acre. The high P rate is currently the highest rate recommended for a soil testing "very low" in extractable P (Adams et al., 1994). No P is recommended when soil test P is rated "high" (>25 mg/kg using M1 extractable P) or "very high" (>50 mg/kg M1 extractable P). A standard N recommendation for annual flowers is 120 pounds total N applied in split applications. Our highest N rate was 120 pounds N applied twice during the season for a total of 240 pounds total N. In the humid southeastern U.S., soils are not normally tested for plant available N and very little is assumed to be mineralized from soil organic matter. Two commercially available fertilizer products were included in the study, Miracle Grow® brand Bloom Booster (10-52-10) and Colorburst® 15-30-15. These were applied to provide the highest rate of P, 120 lb. P_2O_5 per acre per application. Because poultry broiler litter is abundant locally, it was also included to provide the highest P rate as an organic source. The poultry litter used at Cullman and Sand Mountain had the following analysis on a fresh weight basis (N-P_2O_5-K_2O):



Cullman: 4.2-4.6-3.5

Sand Mt.: 3.7-4.0-3.2

The litter was applied assuming a 3-3-2 grade fertilizer. Therefore, 2 tons per acre (2.3 pounds per plot) was applied to provide 120 lb. P_2O_5 per acre. The actual nutrients applied were higher than planned.

Plot size at each location was 5 feet by 5 feet. Three rows of summer annual flowering plants were planted in each plot. At Cullman, 4 plants each of celosia, marigold, and zinnia were planted in each plot after a pine bark mulch was spread. At Sand Mountain, 5 plants of marigold, petunia, and zinnia were planted in each row with no mulch.

At Cullman, data were collected on 5 June, 19 June, 3 July, 17 July, and 31 July. At Sand Mountain, data were collected on 12 June and 19 July. Data recorded included:

- Number of open blossoms per 5-foot row
- Quality of blossoms (Rating from 0= none to 10= very high quality)
- Quality of foliage (0= dead to 10 = large healthy, vigorous, dark green plants)

RESULTS

Research with Volunteers

Objective 2 was addressed by engaging Master Gardener volunteers in field plot research. Most of those involved had no concept of replicated research and the need for applying agricultural statistics to the data. Before beginning, we met with the volunteers to describe the background, treatments, and research process. Volunteers were supervised carefully when establishing the tests and applying fertilizers but the data collection was their total responsibility. About 12 Master Gardener volunteers participated in the project at Cullman and 6 at Sand Mountain. The apparent consensus among the Master Gardener volunteers was that research was not easy; it was a very detailed and laborious process. However, once the final data was shared with them at their regular meetings, and they saw what was accomplished, most were very proud of this work and anxious to move on to a new research project.

Cullman

The effect of fertilizer treatment and plant type on the number and quality of blooms and the quality of foliage by date showed very similar trends at each of the observation dates, 5 June, 19 June, 3 July, 17 July, and 31 July. Tables 1 and 2 are mean values for the entire season. An analysis of variance indicated a significant effect of fertilizer treatment and a significant effect of type of plant on the measured variables but no interaction between type of blooming plant and fertilizer treatment. Therefore, the data indicates that all three types of blooming plants are affected similarly by the fertilizer treatments.

Because this soil tested "very high" in soil test P, no additional P would have been recommended for blooming plants. Indeed, additional P made no difference in the quantity or quality of blooms or quality of foliage (Fig. 2). On the other hand, nitrogen was the most limiting nutrient at this site. Surprisingly, the highest number and quality of blooms and the best foliage were produced at the highest N rate equivalent to 120 lb. N per acre per application. In designing the experiment, we thought that the 120-lb. N/acre rate would have been excessive but this was not the case. Among the two commercial fertilizer products compared, the Colorbust® 15-30-15 was better than the Miracle Grow® 10-52-10 when both were used at the same rate of P because (1) more total N was applied in the Colorburst and (2) part of the total N in the Colorburst product was slow-release. The only significant difference was in the quality of the foliage as would be expected from additional N.

The marigold cultivar seem to produce the largest number of blooms and the best quality foliage of the three types of annual blooming plants used in this study (Table 2, Fig. 2).

Sand Mountain

Data were collected at Sand Mountain on two dates, 12 June and 19 July (Tables 3, 4, and 5). Fertilizer treatment had no significant effect on the number of blooms and the quality of blooms on 12 June. There was a significant effect of treatment on the quality of the foliage by 19 July but this difference cannot be explained. There were some complications at the Sand Mountain location that do not show up in the statistics. Different cultivars of petunia had to be used in some plots because of a lack of the same variety at planting. Most plots had 5 plants of each cultivar but some plots had random plants to die resulting in only 3 or 4 plants. Japanese beetles were also found in some plots. No attempt was made to control insect pests. All these variables may have masked any treatment effect. Regardless, neither N or P seemed to have a significant effect on flowering at the Sand Mountain location. This site also had very high soil test P and was on a site that had been heavily fertilized in past years.

SUMMARY

Additional P is not needed for blooming plants if the soil test is already very high. General obervations and the data suggest that any commercial fertilizer including a high N fertilizer is satisfactory for blooming plants as long as at least 60 lb. N per acre (1.4 lb. N per 1,000 sq. ft.) is applied. Nitrogen rates as high as 120 lb. N per acre (2.8 lb. per 1,000 sq. ft.) applied twice during the growing season were not excessive for best performance of summer annual blooming plants. Poultry broiler litter (chicken litter) at a rate of 2 tons per acre (92 lb. per 1,000 sq. ft.) will provide at least 120-120-60 lb. $N\text{-}P_2O_5\text{-}K_2O$ per acre and was adequate for optimum number of blooms and quality of blooms but produced slightly inferior foliage quality. At Cullman, the marigold cultivar produced the highest number of blooms and best foliage quality compared to the celosia and zinnia cultivars selected.

REFERENCES

Adams, J.R., C.C. Mitchell, and H.H. Bryant. 1994. Soil test fertilizer recommendations for Alabama crops. Agronomy & Soils Dep. Ser. No. 178. Ala. Agric. Exp. Stn., Auburn University, AL.

Tisdale, S.L., W.L.Nelson, and J.D. Beaton. 1985. Soil fertility and fertilizers. 4th ed. Macmillan Co., New York, NY.

ACKNOWLEDGEMENTS

This applied research was conducted with the help and supervision of Arnold Caylor, Superintendent, North Alabama Horticulture Research Center, and Tony Dawkins, Superintendent, Sand Mountain Research & Extension Center. Most of the physical work and data collection were done by Cullman County Master Gardeners and Marshall County Master Gardeners.

Table 1. Effect of fertilizer rate of N and P fertilization on the number and quality of blooms and quality of foliage over the entire blooming season in 2006 at **Cullman** .

Treatment number & description	Fertilizer Rate $N\text{-}P_2O_5\text{-}K_20$	Number of blooms per 5-foot row	Quality of blooms†	Quality of foliage†
	---lb/acre---			
1. no N/no P	0-0-60	27 b	6.7 c	6.3 d
2. no N/high P	0-120-60	26 b	6.7 c	6.5 d
3. medium N/medium P	60-0-60	36 ab	7.7 ab	7.8 ab
4. medium N/high P	60-120-60	34 ab	7.7 ab	7.7 ab
5. high N/no P	120-0-60	40 a	7.6 ab	7.8 ab
6. high N/medium P	120-60-60	41 a	8.0 ab	8.0 ab
7. high N/high P	120-120-60	41 a	8.1 a	8.2 a
8. chicken litter	~120-120-60	40 a	7.8 ab	7.5 bc
9. Miracle Grow® 10-52-10	23-120-23	32 ab	7.5 b	7.1 c
10. Colorburst® 15-30-15	60-120-60	38 a	8.0 ab	8.0 ab

† Scale 0-10 with 10 being the highest quality; values followed by the same letter or not statistically different at the 5% level of probability.

Table 2. Number and quality of blooms and quality of foliage over the 2006 growing season for the three types of blooming plants at **Cullman**.

Type of Flowering Plant	Number of blooms per 5-foot row	Quality of blooms†	Quality of foliage†
Celosia	26 c	7.3 b	7.2 b
Marigold	49 a	7.7 a	7.8 a
Zinnia	32 b	7.8 a	7.4 b

† Scale 0-10 with 10 being the highest quality; values followed by the same letter or not statistically different at the 5% level of probability.

Table 3. Effect of N and P fertilization on the number and quality of blooms and quality of foliage on **12 June** at **Sand Mountain.**				
Treatment no. & description	Fertilizer Rate $N\text{-}P_2O_5\text{-}K_20$	Number of blooms per 5-foot row	Quality of blooms†	Quality of foliage†
	-------lb/acre-----			
1. no N/no P	0-0-60	78	5.8	5.8
2. no N/high P	0-120-60	67	5.5	5.0
3. medium N/medium P	60-0-60	97	5.8	5.8
4. medium N/high P	60-120-60	93	6.0	6.0
5. high N/no P	120-0-60	104	6.3	6.3
6. high N/medium P	120-60-60	83	5.5	5.5
7. high N/high P	120-120-60	68	6.0	5.8
8. chicken litter	~120-120-60	95	5.8	5.8
9. Miracle Grow® 10-52-10	23-120-23	64	5.3	5.3
10. Colorburst® 15-30-15	60-120-60	81	5.3	5.3
L.S.D. $_{P<0.10}$		NS	NS	NS
MEAN		83	5.7	5.6
† Scale 0-10 with 10 being the highest quality				

Table 4. Effect of fertilizer rate of N and P fertilization on the number and quality of blooms and quality of foliage on **19 July** at **Sand Mountain.**

Treatment number	Fertilizer Rate $N\text{-}P_2O_5\text{-}K_20$	Number of blooms per 5-foot row	Quality of blooms†	Quality of foliage†
	---lb/acre---			
1. no N/no P	0-0-60	146	8.3	8.0
2. no N/high P	0-120-60	182	8.3	8.2
3. medium N/medium P	60-0-60	223	8.7	8.7
4. medium N/high P	60-120-60	224	8.9	8.8
5. high N/no P	120-0-60	202	8.8	8.4
6. high N/medium P	120-60-60	180	8.6	8.5
7. high N/high P	120-120-60	212	8.7	8.5
8. Chicken litter	~120-120-60	176	8.3	7.6
9. Miracle Grow® 10-52-10	23-120-23	165	8.3	7.7
10. Colorburst® 15-30-15	60-120-60	210	8.7	8.7
L.S.D. $_{P<0.05}$		NS	NS	0.8
MEAN		192	8.5	8.3

† Scale 0-10 with 10 being the highest quality.

Table 5. Overall mean values for the three cultivars used at **Sand Mountain** on **19 July.**

Type of Flowering Plant	No. of Blooms per 5 feet of row	Quality of Blooms	Quality of Foliage
Petunia	169	8.5	8.2
Marigold	130	8.5	8.4
Vinca	277	8.6	8.3

Miracle Grow®
Bloom Booster
10-52-10 @
23-120-23

0-120-60

No N

Colorburst®
15-30-15 @
60-120-60

120-0-60

No P

Poultry litter @
120-120-80

120-120-60

N + P

Fig. 2. A comparison of selected treatments at Cullman on 3 July 2006 showing celosia, marigold, and zinnia. Rates are pounds per acre of N-P_2O_5-K_2O. (photos by Shirley McEwen, Cullman County Extension Agent Assistant and Master Gardener.)