have produced the usual gibberellin response.

In this study the first mature seed was obtained by the middle of May, indicating that for breeding purposes the reproductive cycle could be shortened to 6.5 months or less. Furthermore, it was observed that regardless of the various treatments for inducing bolting and earliness, the number of true leaves prior to bolting was 10.

High temperature. Plants treated with high temperatures using infrared lamps were stunted and failed to resume normal growth. Bolting began March 25 for the heated plants and April 4 for the control. Forty per cent of treated plants bolted while the control had 20%. Fresh and dry weights were respectively 25 and 5 g/plant for the heated plants and 80 and 16 g/plant for the control. This suggests the ineffectiveness of high temperatures (up to 120°F) in devernalizing plants grown from vernalized seed under neutral temperatures for 80 days.

In the second experiment there was a more rapid growth of the plants in the warm greenhouse a week after transplanting than in the cool greenhouse. Bolters in the warm house were first recorded February 3 and in the cool house on February 18. No difference in the bolting percentage was noted for the 2 treatments suggesting that a temperature of 50° to 65° F for 9 days stabilized the effect of the cold treatment.

Photoperiod. Bolters appeared on February 19 at approximately equal frequency in plants grown under both short and long day conditions. By early March the short day (SD) group appeared more vigorous and by mid-April the difference was very marked. Determination of plant weights showed that the SD group had a total of 1500 g fresh weight, while the long day (LD) group had only 224 g. This indicated that although artichoke is photoperiodically insensitive in regard to flowering, short photoperiods may enhance vegetative growth. Another indication of the lack of response of artichoke to photoperiod was the following observation: All plants sown on November 29 in the greenhouse were kept under natural short day length until December 27, after that date they were placed under artificial light of 15 hr day length; these plants showed a similar bolting pattern to those planted in the field under the long days of April and May indicating that artichoke is not sensitive to photoperiod.

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The Effect of Fertilization on Yield, Growth and Mineral Composition of Southern Peas[1]

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Abstract. In a basic fertility study with the 'Princess Anne' a black-eye variety of southern peas, utilizing a Woodstown sandy loam soil in terra cotta tiles under outside field conditions, an application of 30 lb. N/A increased the yield of pods at greenshell maturity in 1 out of 2 years. Yields increased both years with increasing rate of P application up to and including 200 lb. P/A. Applied K did not increase yields when the soil tested medium or high in available K.

Highly significant increases in plant growth resulted from increasing rates of P application, but plant growth was not appreciably affected by applied N and K. The plant content of P and K increased with the application of each respective element; however, the application of P resulted in a reduction in the level of K in the plants. Applied N did not materially influence the level of N in the plants but did increase the plant content of Ca and Mg; whereas applied K reduced the level of Ca and Mg in the plant.

Introduction

With the development of highly productive determinate bush-type southern peas, *Vigna sinensis,* Endl., the need for information of a more basic nature on its nutritional requirements are apparent. Such information appears, however, to be limited. Patterson and Blackhurst (6) reported a yield increase of pods to 40 lb. N/acre for 3 varieties of southern peas in 1 out of 2 years. Halsey (4) reported a significant increase in yield of southern peas with 18 and 36 lb. N/acre. Campbell et al. (1) found a 34% increase in yield of a purple hull variety of southern pea when 200 lb./A of superphosphate were applied to a soil high in P and medium in K. Godfrey et al. (2) reported that the yield of cowpea forage at early bloom stage increased with applied P.

This paper reports the results of a study in 1966 and 1967 of the basic nutritional requirements of the 'Princess Anne,' a blackeye variety of southern pea, utilizing a series of buried terra cotta tiles under field conditions (Fig. 1).

Materials and Methods

A series of glazed terra cotta tiles 15 inches in diameter and 24 inches deep buried vertically were filled with a Woodstown sandy loam soil, testing low in available P and medium in K. The pH was adjusted to approximately 6.5 with the addition of dolomitic limestone, and adequate amounts of all micronutrients were applied. Fertilization in 1966 and 1967 consisted of

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Table 1. The effect of N, P, and K on yield of pods, growth, and mineral composition of the plant of 'Princess Anne' southern pea at early bloom stage grown in tiles in 1966 and 1967, Norfolk, Va.[a]

Fertilizer treatment lb./A	Pod[b] yield g	Plant[c] weight g	Nutrient composition (oven-dry) N %	P %	K	Ca me/100 g	Mg
Nitrogen							
0	135	2.00	3.65	.269	49	66	46
30	144	2.08	3.53	.267	48	71	54
LSD .05	5	N.S.	N.S.	N.S.	N.S.	2	3
LSD .01	7	N.S.	N.S.	N.S.	N.S.	3	4
Phosphorus							
0	100	1.47	3.62	.229	55	68	53
25	133	1.79	3.61	.262	53	67	51
50	145	1.97	3.65	.267	48	69	51
100	157	2.21	3.57	.283	45	69	51
200	163	2.80	3.53	.301	41	69	52
LSD .05	9	0.34	N.S.	.011	4	N.S.	N.S.
LSD .01	11	0.45	N.S.	.015	5	N.S.	N.S.
Potassium							
0	128	1.90	3.55	.278	36	72	57
25	139	1.95	3.59	.265	47	68	53
50	147	2.18	3.63	.274	52	67	49
75	145	2.16	3.62	.259	59	66	47
LSD .05	8	N.S.	N.S.	.010	3	3	4
LSD .01	10	N.S.	N.S.	.014	5	5	6

[a]2-year average 1966–1967.
[b]Green-shell maturity.
[c]Oven-dry. Total plant sampled at early bloom stage.

0 and 30 lb. N; 0, 25 lb., 50 lb., 100 lb., and 200 lb. P; 0, 50 lb., and 75 lb. K/A, alone and in all possible combinations, in completely randomized blocks with 3 replications. The fertilizers were applied to the same tiles in both years. The seed of the 'Princess Anne' variety was inoculated with a commercial inoculant with the original planting. A sufficient number of seed was planted each year so that 10 plants remained after thinning at the seedling stage. Five plants were harvested at early bloom stage for chemical analysis, and the other 5 plants remained for pod development. The plants were watered as needed. Pods were harvested at green-shell maturity at 2-day intervals for yield records.

Plant samples for chemical analysis were dried in a forced draft oven at 70° C and ground in a Wiley mill to pass through a 20 mesh screen. Total N was determined by the Kjeldahl method. Calcium, Mg, P and K was determined on the plant material after ashing in a muffle furnace at 525° C. Potassium was determined by flame photometry, P colorimetrically as a complex of vanadium phosphomolybdate, and Ca and Mg by atomic absorption.

Fig. 1. General view of experimental tile area, Norfolk, Va.

Results and Discussion

The yield of pods, plant growth, and chemical composition of plants as influenced by NPK fertilization are presented in Table 1.

Effect on pod yield. Nitrogen increased yield in 1966 but not in 1967. The lack of a response to N in 1967 may be attributed to a buildup of inoculum over the previous year. Highly significant yield increases resulted from increasing the rate of P application both years. However, there was a nonsignificant difference between the 100 lb. and 200 lb. P applications. Potassium did not significantly increase yield in 1966, however in 1967 all rates of applied K gave significantly higher yield increases above the 0 potassium treatment. The lower yield at the 0 K treatment resulted from a reduction in level of soil K from medium to low as indicated by soil test.

Effect on plant growth. Plant growth at early bloom stage was not significantly affected by applied N and K. However, highly significant growth increases resulted from increasing rates of P application.

Effect on plant composition. Nitrogen applications had no appreciable effect on the plant analysis for P and K but increased the plant content of Ca and Mg. The P content increased with an increasing rate of P application and was also associated with a reduction in the level of K in the plants. Lawton and Cook (5) have reported that a reduction in the absorption of K by plants is often caused by the addition of P. This reduction has been attributed to an increase in growth and a dilution of K within the plant. The application of K significantly increased the plant content of K, while Ca and Mg decreased as the concentration of K increased. Similar results have been reported by York et al. (7) working with alfalfa and Greig and Smith (3) with sweet potatoes.

The results of this study indicate a more probable yield and growth response of southern peas to applied P than to either N or K. In regard to the basic nutritional requirements of the southern pea, the results of the present work indicate that for maximum pod production the level of soil P should be higher than has been generally realized.

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The Influence of Storage Atmosphere and Temperature on the Physiology and Performance of 'Russet Burbank' Seed Potatoes[1]

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Abstract. 'Russet Burbank' seed potatoes, 4 to 6 oz. in weight, were stored at 0° and 5°C in various levels of O_2 and CO_2. Periodically during the storage season samples were removed for observation of sprouting behavior, bud and parenchyma tissue respiration measurements and determination of the rate of leakage of electrolytes from tissue sections. The performance of the remaining seed potatoes at the end of storage was evaluated in randomized complete block field trials.

The degree of CO_2 toxicity was increased by decreasing the O_2 concentrations and the temperature of the storage environment. Occasionally a reduction in performance with increases in storage CO_2 occurred but more frequently an abrupt drop from good performance to failure resulted. Incipient toxicity during the storage season could occasionally be detected by an increase in the rate of CO_2 evolution from potato buds and increase in electrolyte leakage.

Introduction

The influence of O_2 concentrations less than 21% during storage of 'Russet Burbank' seed potatoes on their respiration and productivity has been reported (7). Respiratory quotients of bud and parenchyma tissue at 5° and 10°C remained close to 1 even in 1% O_2, suggesting a low oxygen requirement to maintain aerobic respiration. The productivity of mother plants grown from seed potatoes stored between 4° and 5° in oxygen concentrations ranging from 2.5 to 21.0% O_2 were similar. Seed potatoes were also stored at 1% O_2 between 4° and 5° C. These were not field tested but after 10 months of storage in 1% O_2 their buds were still viable.

This study was made to delineate further the influence of O_2 and also CO_2 on the productivity and physiology of seed potatoes.

Materials and Methods

Certified 'Russet Burbank' seed potatoes 4 to 6 oz. in weight were selected at harvest from the same field and randomized throughout 2 related experiments. The various atmospheres were passed at a constant rate of 8–10 liters per hour through sealed metal containers holding about 60 lb. of potatoes per treatment. Storage temperatures were 0° and 5°C. The atmospheres were checked with a Hays-Orsatt gas analysis apparatus. Respiratory rates of intact tubers in the storage environments were also determined with the Hays-Orsatt apparatus by taking samples of the air stream entering and leaving the sealed containers.

Cell membrane retention of electrolytes was determined by measuring the rate of increase in conductivity of distilled water which contained tissue sections. These sections were obtained with a 9 mm cork borer and cut 3 mm thick. Twenty five sections from one tuber constituted a sample.

Respiratory rates of parenchyma and bud tissue were determined with a Warburg respirometer on sections removed from the potatoes with a 5 mm cork borer and cut to 4 mm in length. Bud tissue was taken from the apical end and parenchyma sections were chosen at random from surface tissue. To avoid saturating the intercellular spaces the tissue sections were not immersed in water in the Warburg vessels. Water was maintained in the side arm to prevent tissue desiccation.

Coincident with the measurements of cell membrane permeability and tissue section respiration, intact tubers from each treatment were placed at 16°C for sprouting and decay observations. At the end of the storage period, about 2 weeks before planting, the remaining potatoes were cut in half transversely and placed in high humidity at the temperature indicated for the particular experiment. The productivity of the seed potatoes from the various treatments was evaluated using a randomized complete block design with 5 replications. This evaluation was done on the San Luis Valley branch experiment station near Center, Colorado.

To compute the actual partial pressures of O_2 and CO_2 used in the ex-

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Table 1. The influence of storage treatment and temperature on the rate of electrolyte leakage at 20°C from tissue sections.

Storage treatment	Storage temperature	Storage time			
		50 days	100 days	145 days	185 days
Air	0°	105[a]	145	153	153
	5°	32	20	23	21
Air + 4% CO_2	0°	165	148	158	158
	5°	53	52	29	26
Air + 8% CO_2	0°	103	115	148	203
	5°	53	40	51	28
Air + 12% CO_2	0°	73	108	243	Discard
	5°	50	57	50	53
5% O_2	0°	105	168	150	175
	5°	33	32	26	22
5% O_2 + 4% CO_2	0°	92	128	237	175
	5°	63	33	52	41
5% O_2 + 8% CO_2	0°	65	110	165	Discard
	5°	65	50	57	47
5% O_2 + 12% CO_2	0°	65	105	177	Discard
	5°	73	58	63	51

[a]Micromohs per hour; the rate prior to storage was 29. All values are averages of 3 replications.

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