TIME AND LEVEL OF PHOSPHATE AND POTASH FERTILIZER IN RELATION TO YIELD AND DAMAGE SUSCEPTIBILITY OF POTATOES MS 806 ML 1976

Variety - Desiree

Method

The following treatments were applied in a fully factorial trial with two replicates.

Level of Phosphate (kg/ha)	Level of Potash (kg/ha)
(0) = Nil	(0) = Nil
(1) = 150	(1) = 200
(2) = 300	(2) = 400
	(3) = 600

Time of Fertilizer Application

(1) Ploughed down in previous autumn.
(2) Applied to the surface approximately 6 weeks before planting.
(3) Applied to the surface immediately before seedbed preparation.
(4) Split - all phosphate applied to seedbed as in (3).
- 100 kg potash applied to seedbed, the balance having been ploughed down in the previous autumn.

The whole trial area received 440 kg/ha kieserite on 17 September 1975. After cultivation on 22 September and 12-13 November the autumn fertilizer application (treatment 1) was applied on 21 November and the whole area was ploughed on 21-24 November. Fertilizer application 2 was made on 19 February but because of early planting on 9 March the fertilizer was applied only three weeks before planting rather than the intended six weeks. Nitrogen was applied to all plots at 188 kg/ha.

Phosphate was applied as triple superphosphate (47% P_2O_5) and potash as muriate of potash (60% K_2O).

Results - Emergence

Plant counts were made on 7, 11, 14 and 24 May and showed that as the level of potash was increased the rate of crop emergence was reduced. This had been observed in earlier work where muriate of potash was applied to the seedbed and one of the purposes of this trial was to investigate ways of obviating the problem.

Plant numbers were significantly lower at the high potash rates at each of the first three counts. However the count made on 24 May showed an average population of 31,800/ha and there was no significant difference between treatments indicating that final population had not been affected by the fertilizer.

As shown in table 1 the depression in rate of emergence was most marked when the fertilizer was applied to the seedbed. It was reduced somewhat by applying three weeks before planting and was not detectable where the application was split or where the phosphate and potash was all ploughed down. There was no significant effect of phosphate on plant numbers at any time.

Table 1 Plant Population 11 May 000's/ha

Time of fertilizer application	Level of potash (kg/ha) 0	200	400	600	Mean
		(±1.02)			(±0.51)
Autumn (1)	29.8	29.5	28.2	28.3	28.9
Pre-planting (2)	30.3	28.5	27.4	25.3	27.9
Seedbed (3)	29.9	28.6	25.8	24.8	27.3
Split (4)	28.6	27.6	28.5	28.6	28.3
		(±0.51)			
Mean	29.6	28.5	27.4	26.8	

S.E. per plot (47 d.f.) = ±2.51 or 8.9% of G.M.

Growth

On 8 June distinct differences in vigour were observed. Scored on a 0-10 scale the results are shown in table 2. The more vigorous plants received the highest scores.

Table 2 - Vigour Score on 8 June

Level of phosphate(kg/ha)	Level of potash (kg/ha) 0	200	400	600	Mean
		(±0.255)			(±0.127)
0	5.94	6.44	6.06	5.62	6.02
150	6.69	6.44	6.50	6.44	6.52
300	6.81	7.50	6.81	6.50	6.91
		(±0.147)			
Mean	6.48	6.79	6.46	6.19	

S.E. per plot (47 d.f.) = ±0.721 or 11.1% of G.M.

1. There was a very significant improvement in vigour as the mean level of phosphate was increased.

2. There was a reduction of vigour - similar to the reduction in rate of emergence - at the highest level of potash. Study of the detailed results shows that this only occurred when the fertilizer was applied to the seedbed (3) or a few weeks before planting (2).

3. When a further score of vigour was made on 24 August the effect of phosphate had been reduced to an insignificant level but a significant response to potash had become evident. Thus, phosphate had improved early vigour but benefit from potash (unless split or ploughed down) was outweighed by its depressing effect on emergence until quite late in the life of the crop.

Table 3 - Vigour score on 24 August

Time of fertilizer application	Level of potash (kg/ha) 0	200	400	600	Mean
	(±0.208)				(±0.104)
Autumn (1)	5.42	5.92	6.00	5.67	5.75
Pre-planting(2)	5.67	6.08	5.67	5.92	5.83
Seedbed (3)	5.75	6.00	6.17	6.08	6.00
Split (4)	5.33	6.08	6.25	6.33	6.00
	(±0.104)				
Mean	5.54	6.02	6.02	6.00	

S.E. per plot (47 d.f.) = ±0.510 or 8.7% of G.M.

4. Table 3 shows that growth on plots receiving potash was significantly better than those receiving no potash. The table also shows the split application to have been an advantage at the higher rates. More detailed information available shows scores of 6.5 where the higher two rates of potash also received the high rate of phosphate in the split application system. Thus it appears that the phosphate gave the early vigour and this was complemented by potash being available as required. Unfortunately all growth subsequently became severely restricted by drought and much of the improved potential may have been lost.

Leaf Analysis

Leaf samples were taken from each treatment on 14 July and analysed for Ca, P, K and Mg. Ca and P were little affected by treatment but differences in potassium level were found as shown in table 4.

Table 4 - Leaf Analysis - % K

Time of fertilizer application	Level of potash (kg/ha) 0	200	400	600	Mean
Autumn (1)	1.89	2.67	2.61	2.72	2.47
Pre-planting (2)	1.90	2.28	2.41	2.64	2.31
Seedbed (3)	1.85	2.29	2.61	2.61	2.34
Split (4)	1.99	2.43	2.67	2.75	2.46
Mean	1.91	2.42	2.58	2.68	

1. Table 4 confirms the ability of the crop to utilize potash that was ploughed down (treatments 1 and 4).

2. As observed in earlier trials magnesium levels in the leaf were reduced at the higher levels of potassium.

Yield

The trial was harvested on 10 November and riddled on 15 November. Yields were recorded in 30-40 mm, 40-60 mm and 70-80 mm size fractions and at the same time the specific gravity of the 60-70 mm fraction was measured.

The soil analysis of the site before treatment showed phosphate to be index (3) and potash index (1). Magnesium was index (2) in the top 150 mm and index (1) in the 150-300 mm layer. This is a normal analysis for sandy loam of the type found in large areas of East Anglia but although still within index (1) the potash was less deficient than is often recorded.

Table 5 - Ware Yield - t/ha (40-80 mm)

Time of application	Level of potash				Level of phosphate			
	0	200	400	600	0	150	300	Mean
	(±0.90)				(±0.78)			(±0.45)
Autumn (1)	23.4	25.3	25.9	28.9	25.8	25.9	26.0	25.9
Pre-planting (2)	23.0	26.3	27.8	26.9	26.5	26.1	25.3	26.0
Seedbed (3)	23.0	27.4	26.8	28.3	25.7	27.3	26.1	26.4
Split (4)	22.3	25.8	28.0	29.4	26.5	26.4	26.3	26.4
Level of potash					(±0.78)			(±0.45)
0					23.1	22.9	22.7	22.9
200					26.3	26.3	26.0	26.2
400					26.9	26.8	27.7	27.1
600					28.2	29.6	27.3	28.4
					(±0.39)			
Mean					26.1	26.4	25.9	

S.E. per plot (47 d.f.) = ±2.21 or 8.4% of G.M.

1. Phosphate application had a tendency to increase the yield in the smaller size fraction but decrease the yield of larger tubers. Over the whole ware grade there was no effect of phosphate but if moisture had not been so limited it is possible that the larger crop of small tubers would have grown to give a response to phosphate application.

2. Potash increased the yield of tubers in the larger size fractions and gave a significant yield increase of total ware crop.

3. Good responses to potash were also obtained from the higher levels tested particularly in treatments (1) and (4) where most or all of the potash was ploughed down and therefore caused little delay in early growth.

4. The cost of 200 kg of potash @ 10.5p/kg is £21. Thus the cost of the highest level of potash fertilizer is easily justified in yield alone. In addition the potato crop receiving 600 kg of potash removed only 140 kg of the applied potash so that the remaining 460 kg is available to contribute to the soil pool and reduce the potash requirement of succeeding crops.

Blackspot Bruising

Samples of 100 tubers (60-70 mm) were taken from each plot and stored until 10-13 January when they were sliced and examined to determine the incidence of internal blackspot bruising.

Table 6 - % Internal Blackspot

Time of fertilizer application	Level of potash (kg/ha) 0	200	400	600	Mean
	(±1.86)				(±0.93)
Autumn (1)	19.2	8.8	6.5	6.5	10.3
Pre-planting (2)	21.0	4.6	4.2	3.4	8.3
Seedbed (3)	15.9	8.0	3.9	1.7	7.4
Split (4)	15.5	7.3	7.1	3.5	8.4
	(±0.93)				
Mean	17.9	7.2	5.4	3.8	

S.E. per plot (47 d.f.) = ±4.55 or 53% of G.M.

1. Table 6 shows a marked reduction in blackspot bruising as potash fertilizer rate is increased.

2. There is some indication that the autumn application of potash may be less effective in reducing blackspot than when the application is made to the seedbed but this difference did not reach statistical significance and needs further investigation.

3. The level of phosphate had no direct effect on blackspot or any interaction with the potash level in this respect.

Tuber Composition

There was an overall reduction in specific gravity as the level of potash was increased. Although this was statistically significant at the 0.1% probability level it only represented a change from a specific gravity of 1.086 at nil potash to 1.081 at 600 kg/ha. This is equivalent to a change in dry matter of 1%. Phosphate had no effect on specific gravity.

There were indications that the ploughed down potash in treatment (1) was less effective in reducing the spefific gravity than the potash applied at the other times. This is in line with its effect on blackspot bruising.

Samples of 40-60 mm tubers were analysed to determine Ca, P, K, Mg and D.M. These samples confirmed that the dry matter was reduced from 20.4% at nil potash to 19.3% at 600 kg potash/ha. The potassium content was increased from 1.90% at nil potash to 2.08% at 600 kg potash/ha. Time of application also had some effect on the potassium content of the tubers - the lowest being the ploughed down treatment at a mean value of 1.94% and the highest the split treatment at 2.11%.

The usual increase in magnesium content of tubers was noted as potash was increased and phosphorus content was slightly increased by increasing phosphate fertilizer but treatments generally had little effect on tuber analysis in this season.

Conclusions

Like most other trials in 1976 the potential yield and response to treatment were curtailed by the drought. However many useful pointers were observed in this first year of the trial.

1. Although on a high phosphate soil, there was a distinct improvement in early vigour where phosphate was added. There was a tendency for phosphate to increase the yield of smaller tubers but no overall increase in ware yield in 1976. It seems quite likely that if moisture had been more readily available the improved growth would have been reflected in yield.

2. Where potash was applied to the seedbed at planting or three weeks before planting it reduced the rate of emergence of the crop. The plots receiving potash in this way were more backward on 8 June although they had recovered by 24 August. Where the potash was all or largely ploughed down there was no adverse affect from the potash and the later response was just as good as following seedbed application.

3. Analysis of leaves and tubers confirmed that the uptake of potash was as good from the ploughed down treatments (1 and 4) as from the surface applications.

4. Potash fertilizer up to the highest level tested (600 kg) gave a response in yield which was sufficient to justify the cost of the fertilizer application on this soil type. In addition the highest rate would add sufficient potash to the soil pool for most normal crop rotations.

5. Blackspot bruising was reduced by the application of potash fertilizer even when ploughed down although the reduction may not have been as great as that caused by surface application of potash fertilizer.