POTATOES - TIMING AND LEVEL OF PHOSPHATE AND POTASH FERTILIZER IN RELATION TO YIELD AND DAMAGE SUSCEPTIBILITY OF POTATOES - 1978

NAS 806 ML

SUMMARY

On a sandy clay loam soil with ADAS soil index of 3 for phosphate and 1 for potash there was a significant yield response to applied potash up to 600 kg/ha and only a small response to phosphate. In this trial there was little yield response to timing of application.

OBJECT

This experiment examines the timing and level of P and K fertilizer application upon yield and susceptibility to damage of potato tubers.

TREATMENTS

(1) Level of Phosphate (kg/ha)
- a. Nil
- b. 150
- c. 300

(2) Level of Potash (kg/ha)
- a. Nil
- b. 200
- c. 400
- d. 600

(3) Time of Fertilizer Application
- a. Ploughed down in previous autumn
- b. Applied to surface 6 weeks before planting
- c. Applied to surface immediately before seedbed preparation
- d. Split - phosphate applied as in c.
  100 kg/ha potash applied to seedbed, the remainder having been ploughed down in the previous autumn

LAYOUT

2 randomised blocks, fully factorial.

SOIL TYPE

Ashley Series (sandy clay loam)

PREVIOUS CROPPING

Field - Wheate Close

1977	Winter Barley
1976	Spring Barley
1975	Sugar Beet

DRILLED 10th April 1978

HARVESTED 10th October 1978

CONFIDENTIAL*

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SUMMARY

On a sandy clay loam soil with ADAS soil index 3 for phosphate and 1 for potash there was a significant overall yield response to applied potash up to 600 kg/ha, the highest rate examined. There was only a small response to phosphate. In this trial there was little difference in yield where the fertilizers were applied to the seedbed just before planting compared with earlier applications.

Variety - Desiree

Method

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

(1) Level of Phosphate (kg/ha)

a) Nil
b) 150
c) 300

(2) Level of Potash (kg/ha)

a) Nil
b) 200
c) 400
d) 600

(3) Time of Fertilizer Application

a) Ploughed down in previous autumn
b) Applied to the surface approximately 6 weeks before planting
c) Applied to the surface immediately before seedbed preparation
d) Split - all phosphate applied to seedbed, as in (c)
- 100 kg potash applied to seedbed, the balance having been ploughed down in the previous autumn

The autumn fertilizer treatments were applied to the stubble of the preceeding winter barley crop on 23 September 1977 and the whole area was ploughed on 31 October-2 November. The early spring fertilizer treatments were applied on 1 March and the whole trial area received kieserite at 345 kg/ha and nitrogen at 210 kg/ha on 15 March. Seedbed fertilizer was applied on 4 April and worked into the soil by the seedbed cultivations on 5 April. The trial was planted by Robot planter set to give approximately 37,000 setts/ha on 91 cm rows on 6 April.

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 25, 29, 31 May, 2 and 15 June and showed no differences in the rate of crop emergence between any treatment (table 1). Soil conditions in the ridge were relatively moist throughout this period. On 15 June plant counts showed an average of 36,800/ha with little difference between treatments (table 2).

*NOT FOR PUBLICATION WITHOUT THE DIRECTOR'S CONSENT. This report deals primarily with only one year's work so any conclusions given are only tentative.

Table 1 Days to 50% crop emergence

Time of application	Level of potash kg/ha 0	200	400	600	Mean
		(±0.28)			(±0.14)
Autumn	52.5	52.2	53.0	52.7	52.6
Pre-planting	52.8	52.4	52.8	52.4	52.6
Planting	52.7	53.0	53.3	53.1	53.0
Split	52.5	52.9	52.5	52.8	52.7
		(±0.14)			
Mean	52.6	52.6	52.9	52.7	

S.E. per plot (47 d.f.) = ±0 69 or 1 3% G.M.

Table 2 Plant population 15 June 000's/ha

Time of application	Level of potash kg/ha 0	200	400	600	Mean
		(±0.62)			(±0.31)
Autumn	36.9	37.6	37.8	37.6	37.5
Pre-planting	38.9	37.4	37.2	36.9	37.6
Planting	38.2	36.7	37.1	38.4	37.6
Split	38.9	36.7	37.1	38.0	37.7
		(±0.31)			
Mean	38.2	37.1	37.3	37.7	

S.E. per plot (47 d.f.) = ±1.53 or 4.1% of G.M.

Growth

Soil analyses from the site before application of fertilizers showed phosphate to be index 3 and potash index 1. Adequate reserves of lime and magnesium were recorded.

Throughout the season there were marked differences in haulm growth both in vigour and colour due to treatment. The main effects of treatment on haulm growth are given in table 3.

Table 3 Crop growth assessments

Treatment	% Ground Cover 27 June	Haulm Colour Score* 27 June	17 July	% Haulm Senescence 30 Aug.
Time of application	(±1.31)	(±0.12)	(±0.10)	(±1.62)
Autumn	57 7	6.5	7.6	60.4
Pre-planting	64.6	6.5	7.1	59.0
Planting	57.5	6.2	7.3	56.0
Split	60.6	6.5	7.3	59.6
Level of potash (kg/ha)	(±1.31)	(±0.12)	(±0.10)	(±1.62)
0	51.7	7.8	8.6	84.0
200	62.1	6.3	7.5	57.5
400	63.1	5.9	6.9	49.4
600	63.5	5.7	6.5	44.2
Level of phosphate(kg/ha)	(±1.13)	(±0.11)	(±0.09)	(±1.40)
0	54.4	6.4	7.5	54.5
150	61.3	6.6	7.4	62.8
300	64.7	6.3	7.2	58.9
S.E. per plot (47 d.f.)	±6.40	±0.60	±0.51	±7.92
or as % G.M.	10.6	9.3	6.9	13.5

*Colour score: 1 = very pale yellow/green 10 = dark blue/green

In the absence of either potash or phosphate fertilizers haulm growth was noticeably retarded early in the season. Additional potash or phosphate appeared to improve crop vigour and this response was observed up to the highest levels applied. In general foliage colour became lighter with additional potash or phosphate, this effect was most noticeable on the potash treatments.

As in 1977, there was evidence to suggest that the pre-planting and split applications of fertilizers provided the best supply of nutrients early in the season. Examination of the detailed results reveals that the application of potash or phosphate approximately 6 weeks pre-planting consistently gave the best early growth at all levels while ploughing down the fertilizers in the autumn gave the poorest growth. Differences due to timing became less marked in July and August.

At the end of August there was considerable foliage death through natural senescence and this was most advanced on those areas which had not received potash fertilizer. Crop maturity as reflected in foliage senescence decreased with increasing potash level.

There were smaller differences due to level of phosphate. The nil phosphate treatment gave the most vigorous late growth. Timing of fertilizer application did not result in significant differences in haulm senescence.

Leaf Analysis

Leaf samples were taken on 10 July for analysis of P and K content. % P in the leaf dry matter was unaffected by treatment but differences in % K were found as shown in table 4.

Table 4 Leaf analysis - % K

Time of application	Level of potash kg/ha 0	200	400	600	Mean
Autumn	1.62	2.19	3.20	3.55	2.64
Pre-planting	1.42	2.29	2.93	3.31	2.49
Planting	1.52	2.32	3.12	3.43	2.60
Split	1.46	2.27	2.93	3.43	2.52
Mean	1.51	2.27	3.05	3.43	

As in previous trials, potash levels in the leaves were strongly influenced by level of applied potash but in this trial the effect of time of application was small. However, once again, the availability at this time in the growing season of potash ploughed down in the previous autumn was at least as good as other treatments.

Yield

The trial was dessicated with sulphuric acid on 5 September and harvested on 10 October. Yields were recorded in the following size fractions, when riddled on 24 October: less than 40mm, 40-60mm, 60-80mm and over 80mm. At the same time the specific gravity of the 40-60mm fraction was measured. The results are given below.

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

Treatment	Level of potash (kg/ha) 0	200	400	600	Level of phosphate (kg/ha) 0	150	300	Mean
Time of application	($\pm$1.56)				($\pm$1.35)			($\pm$0.78)
Autumn	24.4	34.6	38.3	40.0	34.2	33.4	35.4	34.3
Pre-planting	25.0	36.6	38.0	39.3	34.2	34.7	35.3	34.7
Planting	21.3	35.5	39.0	38.0	32.8	32.1	35.5	33.5
Split	20.5	35.0	39.6	40.9	32.7	33.5	35.7	34.0
Level of potash (kg/ha)					($\pm$1.35)			($\pm$0.78)
0					22.9	20.4	25.1	22.8
200					33.5	34.6	38.1	35.4
400					38.9	38.6	38.6	38.7
600					38.5	40.1	40.0	39.6
Mean	($\pm$0.78)				($\pm$0.67)			
	22.8	35.4	38.7	39.6	33.5	33.4	35.5	

S.E. per plot (47 d.f.) = $\pm$3.81 or 11.2% of G.M.

Over the whole ware grade, phosphate had only a small effect on yields, but produced a significant yield response at the highest level of P, due largely to an interaction with potash level and time of application. Phosphate was most effective when applied to the seedbed in the presence of low levels of potash.

Potash had a major influence on yields at this site. Overall the response to the initial 200 kg/ha potash was 12.6 t/ha which heavily underlines the value of this fertilizer on a soil with a low K index (1). Yields increased with increasing potash up to the highest level applied.

There was no evidence in this year that high levels of potash were any less effective when broadcast and worked into the seedbed than when applied earlier.

Tuber Composition

Treatment	Specific Gravity	% Dry Matter	% P (in D.M.)	% K (in D.M.)
Time of application				
Autumn	1.0945	21.8	0.21	1.54
Pre-planting	1.0921	21.1	0.22	1.65
Planting	1.0902	20.8	0.21	1.68
Split	1.0914	20.9	0.21	1.62
Level of potash (kg/ha)				
0	1.0863	20.3	0.24	1.37
200	1.0944	21.5	0.21	1.50
400	1.0944	21.7	0.20	1.72
600	1.0932	21.3	0.20	1.89
Level of phosphate (kg/ha)				
0	1.0929	21.5	0.21	1.59
150	1.0917	20.9	0.21	1.65
300	1.0916	21.1	0.23	1.63

In general specific gravity and % dry matter measurements were similarly affected by treatments. There was a substantial response to the use of the initial 200 kg/ha K compared with the nil treatment, with both specific gravity and dry matter content of the tubers being increased. Applied phosphate appeared to reduce specific gravity and % dry matter compared with nil phosphate. Time of fertilizer application also appeared to have some effect on specific gravity and % dry matter with the highest values being achieved where P and K were ploughed down in the autumn.

As expected, % K in the tuber increased with increasing levels of applied fertilizer K. Nil phosphate and ploughing the fertilizer in during the autumn both appeared to reduce K uptake in the tubers. However it is interesting to note that there were high P levels in the tubers where no potash was used.

Internal Blackspot

Assessments of the incidence of internal blackspot are currently being made on stored samples and the results will be available later.

G.M.P.

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NAS 806 ML
3rd year

SUMMARY OF BRUISING ASSESSMENTS, ETC. (ADDENDUM)

Samples of 60-80 mm grade ware tubers were examined for internal bruising, incidence of grangrene (phoma exigua) and intensity of enzymic brown staining after 14 weeks storage. Increasing levels of potash led to reductions in the incidence of internal blackspot, gangrene and enzymic brown staining, but caused an apparent increase in internal brownspot.

G.M.P & D.B.S.

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TIME AND LEVEL OF PHOSPHATE AND POTASH FERTILIZER IN RELATION TO YIELD AND BLACKLEG SUSCEPTIBILITY OF POTATOES - 1978 NAS 806 NR
3rd year

Addendum - Assessments on Stored Tubers

After a period of 14 weeks storage in a straw lined unheated building the samples of 60-80 mm grade tubers were examined for incidence of gangrene (phoma exigua), internal black and brown spot and intensity of brown staining of exposed potato slices. A summary of the main effects is given in the following table.

	Gangrene Score*	% Tubers with Blackspot	% Tubers with Brownspot	Brown Stain Score**
Time of application	(±0.12)	(±1.32)	(±0.49)	(±0.18)
Autumn	0.8	31.6	3.5	3.2
Pre-planting	0.8	31.4	4.0	2.8
Planting	0.8	29.0	3.7	2.7
Split	0.9	32.3	3.3	2.8
Level of potash(kg/ha)	(±0.12)	(±1.32)	(±0.49)	(±0.18)
0	1.3	33.5	1.2	4.0
200	0.9	36.3	3.7	3.4
400	0.7	30.1	4.3	2.4
600	0.4	24.4	5.2	1.6
Level of phosphate(kg/ha)	(±0.11)	(±1.15)	(±0.43)	(±0.16)
0	0.9	31.4	4.1	2.8
150	0.6	32.1	3.7	2.8
300	1.0	29.7	3.1	2.9
S.E. per plot (47 d.f.)	±0.61	±6.49	±2.41	±0.88(30d.f.)
or as % of G.M.	73.1	20.9	66.7	30.9

*Gangrene Score 0-10, where 10 = all tubers show lessions, 0 = nil
**Brown Stain Score 0-5, where 5 = dense brown colour, 0= no discolouration after 1 hour

Although there was considerable variability between samples there were noteable differences due to treatment which were statistically significant.

The incidence of gangrenous tubers reduced with increasing levels of potash and was apparently unaffected by time of application. Phosphate level had no clear effect on gangrene.

As in previous trials in this series increasing potash levels reduced internal blackspot, but in this experiment this effect was accompanied by a rise in incidence of internal brownspot which, apart from colour, had many of the superficial characteristics of internal blackspot. However the overall proportion of tubers showing brownspot alone as indicated by the figures given was relatively small. Neither timing of fertilizer application nor level of phosphate appeared to influence bruising.

When slices of stored tubers were exposed to the atmosphere for approximately one hour brown enzymic staining occurred. It was observed that increasing potash fertilizer applied to the crop resulted in a significant decrease in the intensity of this brown discolouration.