SUSPENSION FERTILIZER STUDIES

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Introduction

Fertilizer materials are available as solids, liquids, and gases. Suspension fertilizers are liquids containing suspended solid particles. The development of ammonium polyphosphate has made possible the formulation of high analyses complete suspension fertilizers. Ammonium polyphosphates are water soluble and contain both the poly and ortho forms of phosphate. The polyphosphates complex metal ions such as zinc and iron and keep them available. This process, sequestration, prevents the formation of troublesome precipitates from impurities and makes suspensions excellent carriers of minor elements. Suspensions offer all the advantages of liquid fertilizers such as ease of production, ease of handling, prescription formulation and, in addition, high grade complete fertilizers are possible. It is possible to blend minor elements, herbicides, and insecticides so that every drop of fertilizer is nutritionally uniform. For additional information on polyphosphates and suspension fertilizers consult the 1971 proceedings of the Potato Conference.

In 1970 we started a four year program to study the value of suspension fertilizers for potatoes in the Columbia Basin. Phillips Petroleum Company, Stauffer Chemical Company, and the Washington State Potato Commission provided financial support. Soil and Crop Service at Othello and Cenex, Inc. at Connell assisted in providing equipment and mixing facilities. Technical assistance was provided by TVA personnel.

Experimental Procedures

The suspension fertilizers were prepared by mixing a 9-30-0 solution with urea ammonium nitrate solution, suspension grade muriate of potash and jelling clay. It was found that when properly mixed the fertilizer was stable. The potash did not separate out even after a months time. The first experiment was conducted in 1970. Each fertilizer rate was applied five different ways--all broadcast before plowing, 1/2 broadcast before plowing and 1/2 banded at planting, all banded at planting, 1/2 banded at planting and 1/2 sidedressed, and all sidedressed. The time of sidedressing varied from two weeks after planting in 1970 to when the plants were about six inches tall in 1971 and in 1972.

In 1970 there were five fertilizer rates which ranged from 100 to 500 pounds per acre of N, P_2O_5 and K_2O. A 600 pound rate was added in 1971 and 1972. In 1970 the broadcast fertilizer was sprayed on the land and plowed under. In 1971 it was sprayed on the land and disked into the soil ahead of plowing. In 1972 it was sprayed on the land and rototilled into the soil with a garden rototiller to a depth of about five inches and then plowed under. In 1970 the banded fertilizer was applied through the planter about two inches on each side and slightly below the bottom of the seed as we normally band dry fertilizers. The sidedressed fertilizer was applied about seven inches on each side of the seed two weeks after planting at which time the sprouts were only about two inches long. The injector shanks for sidedressing were mounted on a double toolbar at the rear of the tractor. In 1971 and 1972 the fertilizer bands at the time of planting and at the time of sidedressing were about seven inches on each side of the seed.

The land used for the 1970 experiment had been in potato production for three of the previous four years and water did not sub well into the ridges. The land used in 1971 was planted to potatoes in 1969 and to wheat in 1970. The land used in 1972 was in alfalfa in 1970 and corn in 1971. The stover was plowed under.

Results

1970: By mid May it was obvious that consistent differences in time of plant emergence and method of applying the suspensions were present. Generally, plant growth decreased as the amount of fertilizer applied increased and the greatest decreases occurred from the band applications. At harvest time the tubers indicated there had been a moisture stress problem during the growing season. The moisture stress could have been caused by poor infiltration of the water into the root zone and also by the solubility of the suspension fertilizers. In any case, the condition of the tubers suggested that growth had not been normal and, therefore, none of the data are included in this report.

1971: The 1971 results are shown in tables 1-6. From all of the factors considered, method of fertilization and amount of fertilizer caused differences except in the case of potato chip color which was unaffected by either method of fertilizer applied or amount of fertilizer used.

1972: The results of this experiment are in tables 7-10. As in 1971 both the method of application and the amount of fertilizer used caused an effect on the factors considered.

Table 1. Height of plant above soil in inches June 16--1971.

	Pounds/Acre N, P_2O_5 and K_2O						
Placements	100	200	300	400	500	600	Mean
All Broadcast	15.3	15.9	14.8	14.4	14.6	14.0	14.8
½ Broadcast - ½ Banded	14.9	15.3	13.9	13.3	13.0	13.3	14.0
All Banded	13.0	11.4	11.7	11.4	10.2	9.9	11.3
½ Banded - ½ Sidedressed	13.0	12.8	12.3	11.5	11.8	10.9	12.1
All Sidedressed	12.3	10.9	10.6	11.5	11.2	11.1	11.3
Mean	13.7	13.3	12.7	12.4	12.1	11.9	

Table 2. Total Yield in cwt/acre--1971.

	Pounds/Acre N, P_2O_5 and K_2O						
Placements	100	200	300	400	500	600	Mean
All Broadcast	573	722	757	780	808	774	736
½ Broadcast - ½ Banded	631	702	728	780	731	728	717
All Banded	608	722	688	717	731	685	692
½ Banded - ½ Sidedressed	625	656	668	717	737	699	684
All Sidedressed	565	625	691	705	696	771	676
Mean	600	685	706	740	741	731	

Table 3. Percentage U.S. No. 1 Grade--1971.

	Pounds/Acre N, P_2O_5 and K_2O						
Placements	100	200	300	400	500	600	Mean
All Broadcast	53	61	59	58	56	49	56
½ Broadcast - ½ Banded	57	63	58	45	47	42	52
All Banded	59	56	53	36	34	33	45
½ Banded - ½ Sidedressed	58	65	56	47	44	41	52
All Sidedressed	58	60	45	45	46	38	49
Mean	57	61	54	46	45	40	

Table 4. Specific Gravity at the main harvest--1971.

	Pounds/Acre N, P_2O_5 and K_2O						
Placements	100	200	300	400	500	600	Mean
All Broadcast	1.087	1.082	1.080	1.079	1.084	1.080	1.082
½ Broadcast - ½ Banded	1.085	1.078	1.080	1.078	1.079	1.077	1.079
All Banded	1.082	1.076	1.077	1.074	1.075	1.073	1.076
½ Banded - ½ Sidedressed	1.086	1.083	1.079	1.080	1.074	1.079	1.080
All Sidedressed	1.082	1.081	1.077	1.078	1.076	1.074	1.078
Mean	1.084	1.080	1.079	1.078	1.077	1.076	

Table 5. Blackspot at the main harvest--1971.[1]

	Pounds/Acre N, P_2O_5 and K_2O						
Placements	100	200	300	400	500	600	Mean
All Broadcast	52	56	50	55	53	57	54
½ Broadcast - ½ Banded	54	55	55	57	59	65	57
All Banded	53	57	58	62	60	65	59
½ Banded - ½ Sidedressed	56	54	61	58	61	61	58
All Sidedressed	54	54	57	58	57	58	57
Mean	54	55	56	58	58	61	

[1]/Tubers were stored at 50 F for 1½ months then warmed to 70 F before testing. Blackspot rating: 0-60 = severe; 60-70 = slight; 80+ = no discoloration.

Table 6. Chip Color at the main harvest--1971.[1]

	Pounds/Acre N, P_2O_5 and K_2O						
Placements	100	200	300	400	500	600	Mean
All Broadcast	18	17	18	18	20	17	18
½ Broadcast - ½ Banded	16	16	16	17	18	17	17
All Banded	19	17	16	16	17	16	17
½ Banded - ½ Sidedressed	18	17	19	17	17	15	17
All Sidedressed	15	17	16	19	17	16	17
Mean	17	17	17	17	18	16	

1/ Tubers stored the same as for blackspot but reconditioned 1 month at 70 F before testing. The higher the value the lighter the chip color.

Table 7. Total Yield in cwt/acre--1972.

	Pounds/Acre N, P_2O_5 and K_2O						
Placements	100	200	300	400	500	600	Mean
All Broadcast	660	785	791	785	785	820	771
½ Broadcast - ½ Banded	674	692	768	788	788	768	746
All Banded	712	692	715	733	727	706	714
½ Banded - ½ Sidedressed	718	738	701	768	744	791	743
All Sidedressed	636	680	701	715	756	756	707
Mean	680	717	735	758	760	769	

Table 8. Percentage U.S. No. 1 Grade--1972.

	Pounds/Acre N, P_2O_5 and K_2O						
Placements	100	200	300	400	500	600	Mean
All Broadcast	80	81	78	81	78	75	79
½ Broadcast - ½ Banded	81	75	79	76	73	73	76
All Banded	85	81	79	78	73	75	78
½ Banded - ½ Sidedressed	80	79	77	76	74	72	76
All Sidedressed	78	82	82	74	71	71	76
Mean	81	79	79	77	74	73	

Table 9. Specific Gravity at the main harvest--1972.

	Pounds/Acre N, P_2O_5 and K_2O						
Placements	100	200	300	400	500	600	Mean
All Broadcast	1.089	1.085	1.088	1.085	1.086	1.084	1.086
½ Broadcast - ½ Banded	1.089	1.087	1.087	1.085	1.084	1.082	1.086
All Banded	1.088	1.086	1.085	1.084	1.084	1.082	1.085
½ Banded - ½ Sidedressed	1.087	1.088	1.087	1.084	1.083	1.081	1.085
All Sidedressed	1.089	1.087	1.087	1.083	1.083	1.083	1.085
Mean	1.088	1.087	1.087	1.084	1.084	1.082	

Table 10. Blackspot at the main harvest--1972.[1]

	Pounds/Acre N, P_2O_5 and K_2O						
Placements	100	200	300	400	500	600	Mean
All Broadcast	46	51	45	48	49	58	49
½ Broadcast - ½ Banded	44	50	44	49	52	54	49
All Banded	47	43	52	53	58	55	51
½ Banded - ½ Sidedressed	50	46	50	48	53	55	50
All Sidedressed	46	51	51	57	52	60	53
Mean	46	48	49	51	51	53	56

[1] Tubers were stored at 50 for 1 month then moved to 40 F for 1 month then warmed to 70 F before testing. Blackspot rating: 0-60 = severe; 60-70 = slight; 80+ = no discoloration.

Summary

Our experience over the past three years has shown that suspension fertilizers can be used successfully in potato production. Broadcast applications of suspension fertilizers have been superior to band applications except at low fertilizer rates. Suspensions have tended to create salt problems if placed too close to the seed piece, especially at the higher fertilizer rates.

This coming year we will continue our testing of suspension fertilizer but with a somewhat different approach. We will discontinue all sidedressing, we will have our test plots in commercial fields and we will include field trials in some of the early marketing areas. In addition, there will be direct comparisons between suspensions and selected dry fertilizer formulations.