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Tel. +33 1 53 93 05 00 - Fax +33 1 53 93 05 45/47 - ifa@fertilizer.org - www.fertilizer.org

EXPERIMENTATION ON THE USE OF UREA-AMMONIUM SULPHATE (UAS) LIQUID FERTILIZER IN KUWAIT

by M.F. ABD EL-HAMEED, Petrochemical Industries Company, Kuwait

The agricultural development in Kuwait faces some difficulties due to:

1. Adverse climatic conditions
2. Very limited natural fresh water resources
3. The lack of naturally fertile soil

In order to circumvent these constraints the Government of Kuwait initiated an intensive research programme to investigate the possibility of promoting vegetable production through the adoption of certain advanced cultural techniques. Protected vegetable production uses now in Kuwait on a large scale drip irrigation systems. Liquid fertilizer is essential for use with drip irrigation systems. That is why the Petrochemical Industries Company started its experiments for producing a new liquid fertilizer using its main products urea and ammonium sulphate mixture as a source of nitrogen and sulphur.

With the cooperation of the Department of Agriculture, Ministry of Public Works has put the liquid fertilizer (UAS) at the field experiment scale for about three years using different types of vegetables getting a good result by using the (UAS) liquid fertilizer.

LABORATORY EXPERIMENTS FOR PREPARATION OF THE (UAS)

There are three important factors to be taken in consideration in preparing the urea-ammonium sulphate mixture:

1. The maximum possible nitrogen content in solution
2. The minimum solidification temperature of the urea and ammonium sulphate solution
3. The possibility of preparing such mixture from the urea and ammonium sulphate production steps that contains both of them in solution form for easy and large scale preparation.

From the solidification curves of urea and ammonium sulphate (Curve n° 1), according to the low temperature required, urea concentration should be between 30 and 40% wt. and the ammonium sulphate concentration should be between 20 and 30% wt.

Different solutions with different urea and ammonium sulphate concentrations have been prepared and the solidification has been determined (Table n° 1) and plotted against the total nitrogen content of each solution (Curve n° 2), the inclination point on the curve showing the highest nitrogen content (22% wt) at the lowest solidification temperature obtainable (4° C) and this solution can be easily prepared by mixing a solution from the storage tank at urea plant and the mother liquor tank from ammonium sulphate plant having the following specifications:

a. Solution from urea storage tank

Specific gravity at 70° C	1.155
Total nitrogen content	33% wt
Urea content	75.5% wt
Free ammonia content	0.43% wt

b. Solution from mother liquor tank

Specific gravity at 20° C	1.250
Total nitrogen content	9.07% wt
Ammonium sulphate content	42.75% wt
Acidity as (H_2SO_4 acid)	0.25% wt

The final mixture of liquid fertilizer (UAS) have the following specifications:

Total nitrogen content	22% wt
Sulphur content	5% wt
Solidification temperature	4° C

Table 1

No	$(NH_4)_2SO_4$ %	Urea %	H_2O %	T.N_2 %	Solid. Temp.
1	14.10	50.00	35.9	37.1	28° C
2	24.94	38.06	36.2	22.74	15° C
3	14.21	43.54	42.25	23.01	13° C
4	21.20	37.60	41.2	21.71	4° C
5	21.00	35.0	44.0	20.51	1° C
6	15.00	15.00	70.0	10.05	- 13° C

FIELD EXPERIMENTS ON THE UREA-AMMONIUM SULPHATE (UAS) LIQUID FERTILIZER

The aim of these experiments was to find the effect of the (UAS) as a new source of nitrogen on the different kinds of vegetables when added as a single dose or divided into equal doses.

These experiments were based on fixed conditions and treatments except the source of nitrogen in the fertilizer used.

The latin square method was used having two pieces of land one of which mixed with manure (cow manure) and the other without on the following basis:

1. The complex fertilizer 12 + 12 + 17 + 2 was used as a reference.
2. The liquid fertilizer (UAS) was added in a portion that contains the same percentage of nitrogen found in the complex fertilizer.
3. UAS was applied in three different ways:
   a. in one dressing
   b. in two equal rates
   c. in three equal rates
4. The water used for irrigation was sweet water containing 250 - 500 ppm as total dissolved salts and having a pH of 8.5.
5. The plants used for these experiments were:
   a. Tomato
   b. Radish
   c. Lettuce
   d. Potato
   e. Onion

The results of these experiments are summarized as follows:

Table 2

Plant	UAS addition	With manure			Without manure		
		NPK prod. kg/1000 m^2	UAS prod. kg/1000 m^2	Differences %			
Tomato	One dose	3330	3700	+ 11.1	3015	2960	- 1.82
	Two doses		3215	- 3.45		2812	- 6.73
	Three "		3053	- 8.31		2997	- 0.60
Potato	One dose	3822	4489	+ 17.45	4311	4666	+ 8.23
	Two doses		5155	+ 34.87		5200	+ 20.62
	Three "		4711	+ 23.26		4978	+ 15.47
Onion	One dose	6580	6497	- 1.41	6248	6164	- 1.34
	Two doses		6831	+ 3.81		6580	+ 5.31
	Three "		7081	+ 7.61		6331	+ 1.33
Lettuce	One dose	2749	2916	+ 6.07	3000	3748	+ 24.93
	Two doses		3332	+ 21.2		4165	+ 38.83
	Three "		2999	+ 9.09		3665	+ 22.17
Radish	One dose	3295	2991	- 9.23	2742	3213	+ 17.18
	Two doses		3269	- 0.79		2742	0.0
	Three "		2964	- 10.04		2909	+ 6.10
	One dose				14250	13670	- 4.1
	Two doses					14250	+ 0.0
	Three "					13988	- 2.10

The final results of experiments show that the liquid fertilizer (UAS) has a good effect on the vegetables as a source of nitrogen and sulphur.

According to Curve n° 3 we can conclude that:

a. In case of tomato it can be used in one dose.

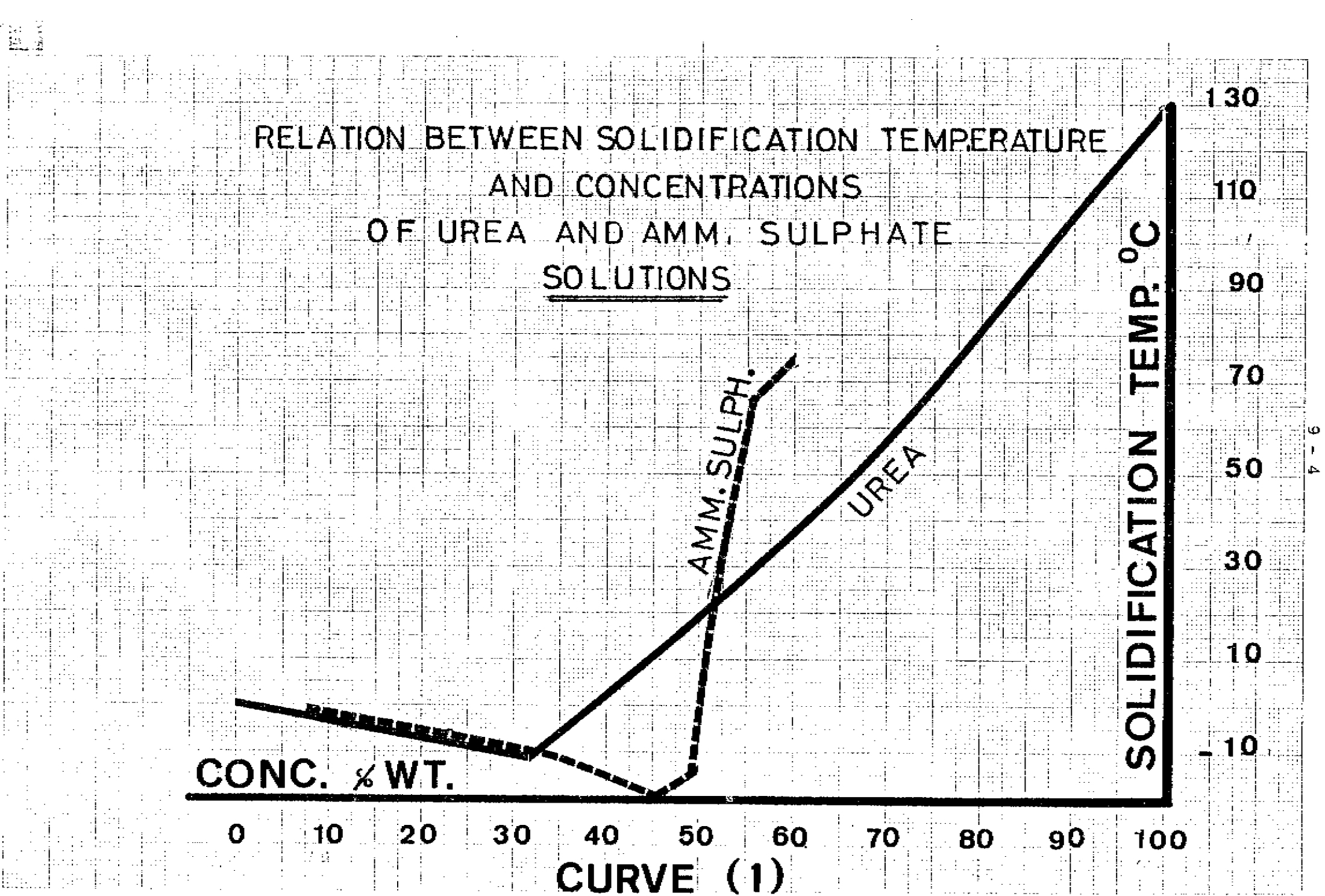
b. In case of potato it is better to be used in two equal doses.

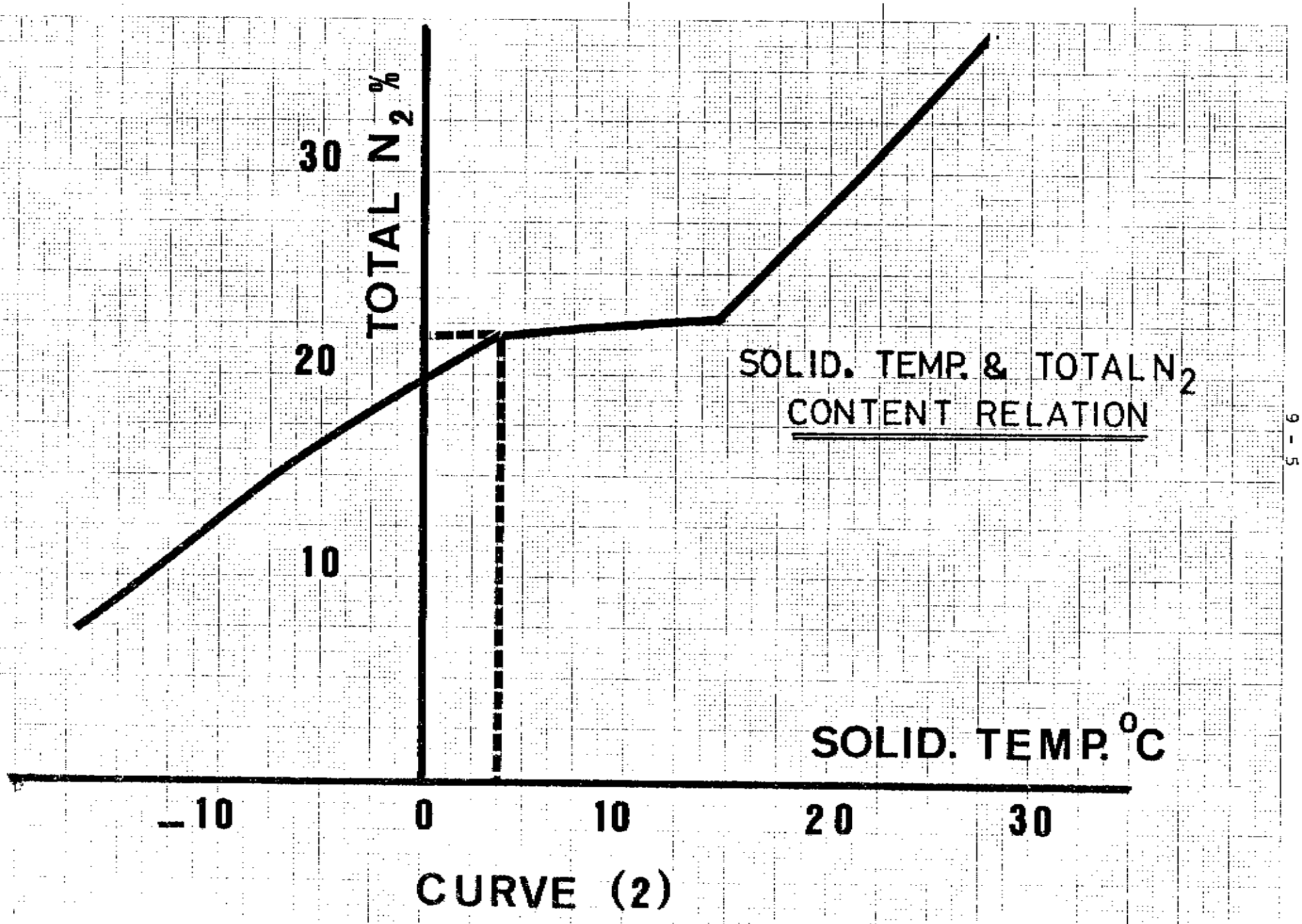
c. In case of onion it can be used either in two or three equal doses.

d. In case of lettuce the best results can be obtained by using the liquid (UAS) on two equal doses.

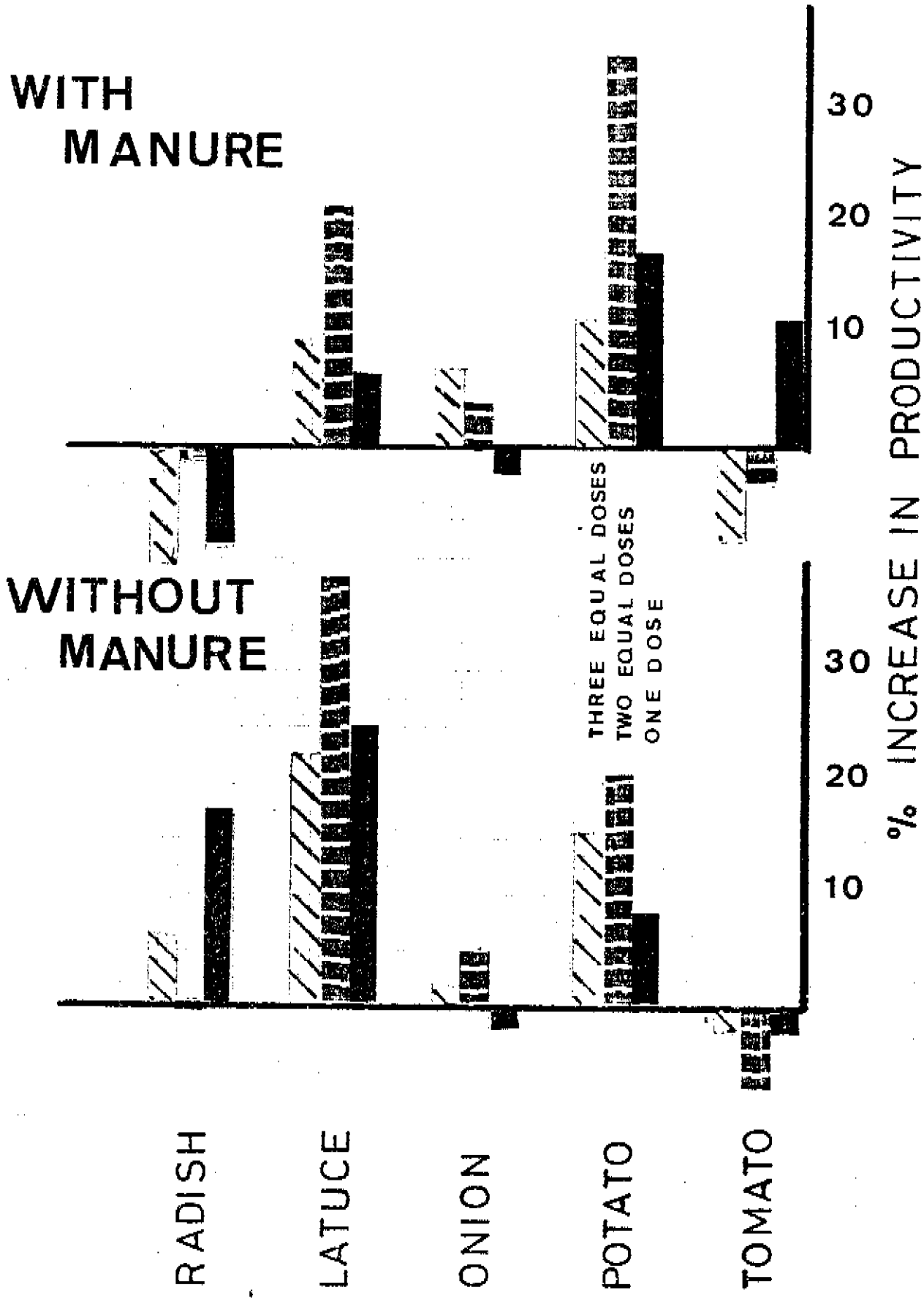
e. In case of radish it can be used in one dose.

In general the liquid fertilizer (UAS) can be used as nitrogen and sulphur sources for the plants as one or two equal doses.


RELATION BETWEEN SOLIDIFICATION TEMPERATURE
AND CONCENTRATIONS
OF UREA AND AMM. SULPHATE
SOLUTIONS
AMM. SULPH.
UREA
SOLIDIFICATION TEMP. °C
130
110
90
70
50
30
10
-10
CONC. % WT.
0
10
20
30
40
50
60
70
80
90
100
CURVE (1)


TOTAL N_2 %
30
20
10
SOLID. TEMP. & TOTAL N_2
CONTENT RELATION
SOLID. TEMP. °C
-10
0
10
20
30

CURVE (2)



% INCREASE IN PRODUCTIVITY OF VEGETABLES BY USING LIQUID U A S

CURVE (3)

Presentation of experimentation in usage of urea, ammonium sulphate (UAS) liquid fertilizer in Kuwait

No of Slide	Nature	Description	Comments
1	Curve (1)	Solidification temp. and concentration curve	Gives the relation between the solidification temperature and concentration of urea and ammonium sulphate.
2	Curve (2)	Solidification temp. and total N_2 content curve	Gives the relation between solidification temperature and total nitrogen content of liquid (UAS)
3	Curve (3)	Increase in productivity curve	Gives the increase in productivity of some vegetables by using the liquid (UAS).

TA/84/9 Experimentation on the use of urea-ammonium sulphate (UAS) liquid fertilizer in Kuweit, by M.F. Abd El-Hameed, Petrochemical Industries Company, Kuweit

DISCUSSION: Rapporteur N.D. WARD, Norsk Hydro Fertilizers Ltd, United Kingdom

Q - Mr. B.K. JAIN, FAI, India

Same results could possibly be achieved by balanced application of urea and SSP. Has the economics of application of fertilizers in various forms been worked out and how does it compare with UAS solution?

A - 1. Table 1 shows the laboratory experiments to obtain a solution with the maximum nitrogen content (that is for transportation reasons) and the lowest solidification temperature to prevent the solidification of the solution during winter time.

2. Solution n° 4 (table 1) is the most suitable one according to our needs.

3. We could not fix the sulphate contents and change the urea content of the solution, because we do not know the behaviour of the mixture and the urea itself has very high solidification temperature as shown from curve n° 1, so we used different concentrations of ammonium sulphate and urea until we get table 1 and from which we get curve n° 2.

Q - Mr. G.H.M. CALIS, UKF, Netherlands

In constructing figure 2, solutions with different (NH4)2SO4 content have been used (see table 1). We believe that only solutions with the same sulphate content should be compared. Can you comment on that? In table 2, you compare NPK with NS fertilizer. Conclusions based on this comparison could be doubtful. Would it not be possibly better to compare UAS with straight N or NS fertilizer?

Q - Mr. A. EL-HOUARI, OCP, Morocco

For field trials, was UAS used alone or with the addition of equivalent amounts of P2O5 and K2O contained in NPK fertilizers used as references. If so, in which form were P2O5 and K2O added. If not, are the results obtained not affected by the absence of these two elements?

A - The (UAS) was compared against NPK (12+12+17+2) for the following:

a) The NPK (12+12+17+2) is the most commonly used fertilizer in Kuweit.

b) The comparison was only for the nitrogen and sulphur source, so the NPK were used according to the normal methods of agriculture with the quantity required for each plant.

For the (UAS) we used a dilute solution containing the same nitrogen % (12%) as the NPK for drip irrigation, the other elements (P&K) were mixed with the soil with the same percent as they are found in the NPK, so as to make all the other factors (except the nitrogen and sulphur sources) stable.

Q - Mr. C.H.M. VINKE, Windmill Holland, Netherlands

I have a question on distribution and storage. Can you indicate the distance between the point of production and the point of application of this fertilizer?

A - Our factories are very near to the agricultural area in Kuweit, the distance is 5-10 km. We use, in our field scale experiments, tanks to transport this solution to the agricultural area. The solution is still only produced and used on an experimental scale. Until now we have not produced it on a large scale.

Q - Do you have any idea of the maximum distance you will be able to cover by this method of fertilizer supply.

A - I think we can transport if for any distance because we already transfer ammonia solution from Kuweit to the outside world which requires more precautions than UAS solution.