PLACEMENT OF FERTILIZERS

by

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INTRODUCTION

Experimental work on trial fields in the Netherlands has shown that generally speaking, placement of fertilizers in bands is better than broadcasting them evenly over the surface and then harrowing them in.

The investigations have been carried on for some years on oats, spring wheat, maize, pulse crops, potatoes and beets. In most of the experiments placing and broadcasting were tested at three or four rates of fertilizer. Besides, a treatment without fertilizer was arranged. The fertilizers used were superphosphate, sulphate of potash and ammonium nitrate limestone. Broadcast fertilizer was harrowed in shallowly; placed fertilizer was localized in grooves at a certain distance from the seed, in the first year applied by hand later on by a special machine in combination with sowing the seed. Preliminary inquiries showed that the germination of the crop was injured when the fertilizer was drilled in contact with or below the seed, especially when highly-soluble fertilizers (ammonium nitrate limestone and sulphate of potash) were used on pulse crops and beets. For cereals bands placed 2 cm and for other crops 5-7 cm to the side of the seed were safe. In all cases the fertilizer was applied about 2 cm below the level of the seed, for cereals and puls crops in one band, for other crops in two bands on both sides of the seed. The thickness of the band was 3-5 cm.

RESULTS OF THE EXPERIMENTS

About 80 experiments were carried out in 1948-1954 to compare placement and broadcasting. First we will discuss the results of some trial fields to show the difference in effect between the two methods of application, after that we will give a summary of all the results.

On soils deficient in phosphate placement proved to be better than broadcasting especially with pulse crops, maize and cereals. For beans it is illustrated in fig. 1, where yields are plotted against the quantities of phosphate applied.

Placement of superphosphate near the seed makes maize grow more quickly and gives higher yields than broadcast dressing. Fig. 2 represents the results of one of our experiments with maize. This trial field was carried out with the purpose to compare placement and

broadcasting in dependence on the phosphate content (P-citr) of the soil. Widely divergent phosphate contents resulted from different dressings in previous years. Across the different phosphate conditions, both methods of application are compared at 0, 30, 70 and 150 kg/ha P_2O_5 as superphosphate. The yield reacts favourably to these phosphate dressings particularly if the fertilizer is applied in bands. The effect

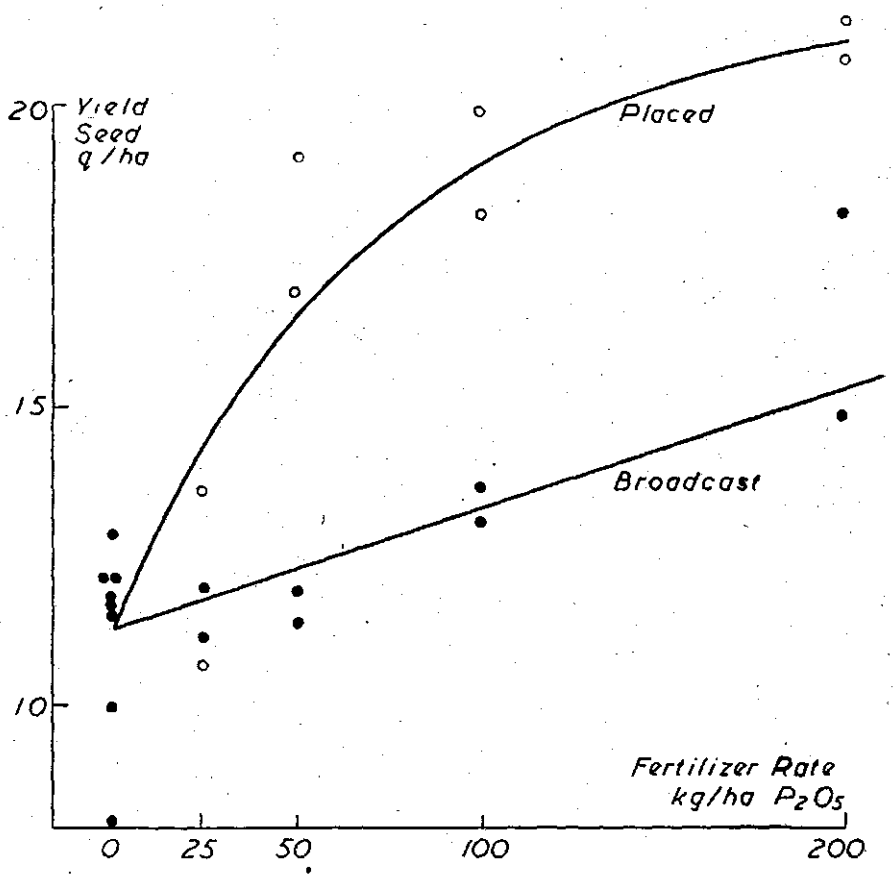

FIG. 1
Comparison between row placement (o) and broadcasting (o) with phosphate for beans.

of phosphate dressing both broadcast and placed diminishes as P-citr increases. At a fairly high level of readily available phosphate present in the soil none of the dressings of placed fertilizer gave any worthwhile yield increases.

Table 1 gives an example of a favourable effect of placement with superphosphate on oats. It can be seen that a deep localisation (4 cm below the seed level) was more profitable than a shallow situation.

TABLE 1

YIELDS OF GRAIN (OATS) IN q/ha ON RECLAIMED HEATH SOIL

Methods of application	kg/ha P_2O_5			
	0	40	80	200
Broadcast	0	8,6	15,9	23,7
Placed 0 (1)		10,3	15,4	17,1
2		15,9	20,2	21,7
4		19,0	18,6	22,7

(1) Position of the fertilizer band in cm below the seed level.

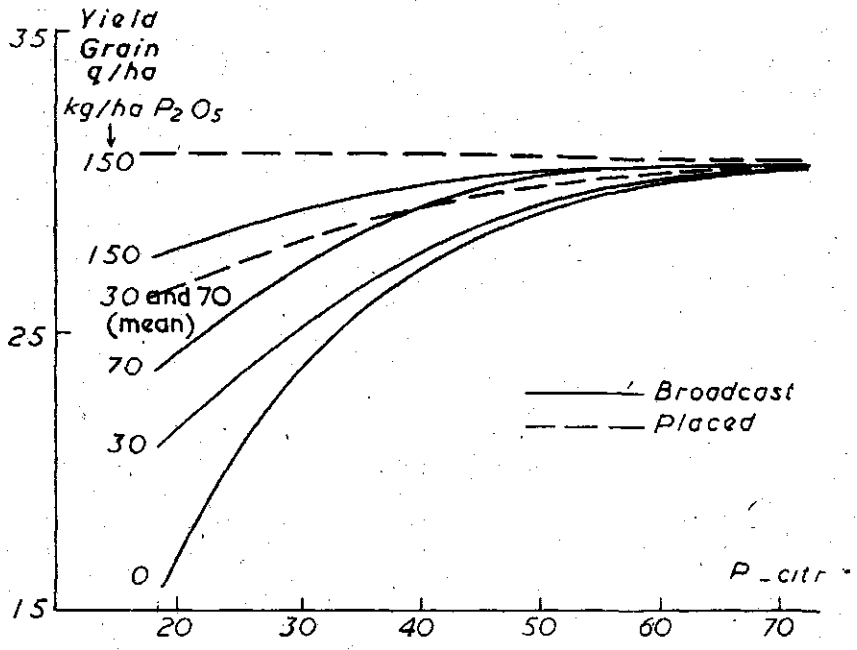

FIG. 2

Comparison between row placement and broadcasting with phosphate for maize in dependence on P-citr.

Similar results are obtained by placing sulphate of potash on riverclay deficient in potash for spring wheat and potatoes. Yields given by a single dressing of sulphate of potash placed in bands were about equal to the yields given by double dressings of broadcast fertilizer. Placing nitrogenous fertilizer shows a marked effect which is however less than that of phosphorous and potassium fertilizers (table 2).

TABLE 2

YIELDS OF GRAIN (OATS) IN q/ha

Method of application	kg/ha N			
	20	40	60	80
Broadcast.	18,5	24,2	32,0	37,8
Placed	18,6	28,8	36,1	38,3

Placement of nitrogenous fertilizer makes potatoes and beets grow longer than in the case of broadcast manuring.

Summarizing the results of all experiments, the yields of each trial field have been plotted against the fertilizer dressings, from which comparative numbers have been calculated indicating the ratio between the additions of fertilizer giving the same result in yield for placement and broadcasting. This value is computed through the displacement of the curve for broadcasting parallel to the axis, on which the fertilizer dressings are plotted. The conjunction of both curves proved to be admissible after testing by the m-ranking method of *Kendall* (3).

Table 3 presents the value of placement in comparison with broadcasting as a mean of all experiments. In the first place this value depends upon the kind of plant nutrient. Applying nitrogenous fertilizer in bands is more effective than broadcasting; phosphorous and potassium fertilizers sometimes give considerably better results if placed in bands near the seed. This may be attributed to the rather small uptake of phosphate and potash when broadcast in consequence of fixation. A localised concentration of fertilizer reduces the fixation to a minimum and will have a favourable influence on the uptake.

TABLE 3

VALUE OF PLACEMENT IN COMPARISON WITH BROADCASTING (=1,00)

Crop	Nitrogen	Phosphate	Potash
Cereals	1,25 (14) (1)	2,00 (15)	3,30 (4)
Maize	—	2,00 (8)	—
Pulse crops	—	6,70 (2)	—
Potatoes	1,20 (5)	1,25 (9)	1,45 (12)
Beets	1,20 (4)	1,10 (5)	1,00 (1)

(1) Number of experiments.

The effect of placed superphosphate is greatest with pulse crops, followed by cereals and maize with a somewhat slighter benefit. Placement for potatoes and beets gives less profit. The effect of placed sulphate of potash is also for potatoes less great than for cereals.

Our investigations confirm the conclusions of Cooke (1) that placement is of particular value for crops having a limited root range (cereals and pulse crops. Crops having a well-developed lateral root system (potatoes and beets) can take up nutrients in the soil between the rows. In contrast, maize has an extensive root system and placing superphosphate was much better than broadcasting. It is well-known that in the early stages of growth maize can suffer severely from phosphate deficiency. Possibly the first-formed roots do not quite reach the broadcast fertilizer that is shallowly incorporated, owing to which the uptake is small.

Placement of sulphate of potash on riverclay for potatoes is effective only at high pH. In this case the availability of potash for this crop is extremely low *(Ferrari,* 2). A better effect of placement of superphosphate with potatoes has only been found on ferrous soils.

LITERATURE

(1) COOKE G.W. Recent advances in fertilizer placement II. Fertilizer placement in England. Journ. of the Sci. of Food and Agric. 5 (1954) 9, 429-440.

(2) FERRARI Th.J. An agronomic research with potatoes on the river ridge soils of the Bommelerwaard. Versl. Landbouwk. Onderz. 58. 1 (1952).

(3) KENDALL M.G. Rank correlation methods. Charles GRIFFIN and Company Lim. London 1948.

ZUSAMMENFASSUNG

Die Differenz zwischen Reihendüngung und Breitdüngung kann in einem Faktor dargestellt werden, welcher das Verhältnis der benötigten Mengen Dünger gibt, um für beide Methoden dieselben Erträge zu erhalten. Reihendüngung mit Phosphorsäure und Kali ist zweimal effektiver als Breitdüngung, mit Sitckstoff 1,2 mal, Besonders effektiv ist Reihendüngung für Hülsenfrüchte, Getreide und Mais und auf Böden mit hoher Fixierungsfähigkeit Festlegung.

SUMMARY

The difference between placement and broadcasting can be reproduced by a factor indicating the ratio between the additions of fertilizer giving the same result in yield for both methods of application. Phosphorous and potassium fertilizer applied in bands are about twice as effective as broadcasting; nitrogenous fertilizer 1,2 times. Placement is of particular value for pulse crops; cereals and maize and on soils with a high fixation capacity.

RÉSUMÉ

La différence entre la fumure en bandes et à la volée peut être indiquée par un facteur donnant la proportion des doses d'engrais nécessaires pour les deux méthodes pour obtenir les mêmes rendements des récoltes. Les fumures phosphatées et potassiques appliquées en bandes sont deux fois plus efficaces que celles à la volée, la fumure azotée l'est de 1,2 fois. La localisation des fumures est particulièrement efficace pour les cultures à cosses, céréales et maïs et sur les sols qui ont un pouvoir de fixation élevé.