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'Hollow noses' in hyacinth, a disorder caused by the herbicide chlorpropham

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Abstract

A malformation in hyacinths, first observed in recent years, was found to be an effect of uptake by the roots of the herbicide chlorpropham. The risk of this malformation is even present when normal doses of this compound are used for weed killing, especially on sandy soils with very little organic matter and under conditions of shallow planting.

Introduction

In recent years growers noticed a malformation of hyacinth bulbs without obvious cause. The abnormality occurred especially on newly reclaimed sandy dune soils, which are very low in organic matter (less than 1 %). It became also evident that shallow and irregular planting of the bulbs increased the incidence of the disease too. This drew attention to the uptake of weedkiller by the roots as a possible causative factor in the disorder.

Description of the malformation

In extreme cases the leaves of plants producing malformed bulbs are broad, slightly distorted, and shorter than normal. The part of the leaves between the soil surface and tip of the bulb shows thickening. Usually, however, no abnormalities are formed during the growing season in stocks which show 'hollow noses' in storage. As harvest time approaches, the normal leaf abscission of the leaves does not occur. Often the bulbs are not normally rounded but are flattened at one side near the bottom. The flower stem dies off down to the bottom of the bulb and the bulb scales formed as basal parts of the leaves are discoloured, i.e. greyish with waxy, slightly cream-coloured spots.

During storage, the tips of the bulb scales become necrotic and desiccated. A cavity, the size of which depends on the degree of incomplete growth, is formed in the apex of the bulb. Hence, Dutch growers call this phenomenon 'hollow noses' (holle neuzen) (Fig. 1).

In affected bulbs the main bud is weak or absent. Many young bulbs develop from adventitious buds between the scales and externally around the basal plate. The plants emerging in the following spring show many sprouts, resembling those developing

Fig. 1. Hyacinth 'Delfts Blauw' bulbs showing various symptoms of 'hollow noses'.

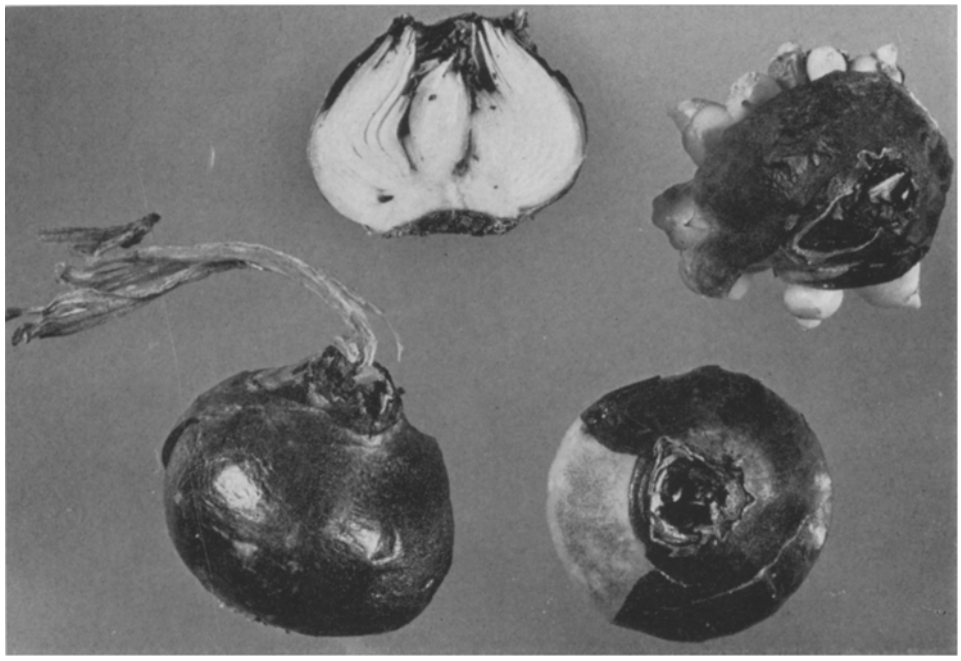

Fig. 1. Bollen van hyacint 'Delfts Blauw' met verschillende symptomen van 'holle neuzen'.

from bulbs scooped for propagation. In most cases the old bulb scales disappear completely, and a group of new, rather small bulbs held together by the old basal plate is harvested.

Incidence of the malformation

All cultivars can show this malformation, but 'City of Haarlem', 'Carnegie', 'Pink Pearl', and 'Delfts Blauw' are particularly sensitive.

The disease occurs mainly on soils improved in recent years by deep dugging with a suction dredger or dragline, which results in a low rate of organic matter ($<1\%$). The longer a particular soil is under cultivation, the higher the content of organic matter and the smaller the chance on the occurrence of the disease. The damage in certain stocks varied from 1% to 80% of inferior bulbs.

Material and methods

Two field experiments and one pot experiment with sandy dune soil concerning the effect of the herbicide chlorpropham (chloor-IPC 40%) were carried out.

Field experiment 1. In 1969/1970, bulbs of the cultivar 'City of Haarlem' (size 10–12 cm) were planted at depths of 4 and 8 cm, respectively. Chlorpropham was applied in

various ways in a dose of 8 l/ha. The chemical was sprayed either on top of the soil or – after removal of the top layer – directly at root level. In some treatments after application the soil was drenched with 20 mm water.

Field experiment 2. In a similar experiment in 1970/1971 with 'Carnegie' (size 10–12 cm), bulbs were planted at depths of 4, 8 and 12 cm. The influence of mechanical planting was also studied. Since mechanically planted bulbs land in different positions, in the experiment the bulbs were planted upright and upside down. In the latter case the herbicide of course comes into contact with the roots more easily.

Pot experiment. In a pot experiment done in 1969/1970, chlorpropham was applied at two times, by two methods, and in four concentrations. The weedkiller was applied to the roots after removal of the soil or poured into the cylinder formed by the leaves. The pots, filled with newly reclaimed dune sand had been planted with four bulbs of cv. 'Delfts Blauw' (size 12–13 cm) at the end of November.

Results

In the *field* experiments, anomalous growth occurred soon after the application of chlorpropham to the roots by washing in and especially when the herbicide was given in the root zone after removal of the soil. After the latter treatment the plants were slightly deformed and shorter than the controls, and the flower stalks were thickened. The cut surface of bulbs sliced longitudinally already showed the typical creamy discolouration arising in the base. At harvest time the leaves could not be broken off easily. The basal parts of the leaves were not white and fleshy but grey or creamy, and the texture was somewhat waxy. In some cases young bulblets had already been formed. After three weeks of storage at 30 °C, the temperature at which hyacinth bulbs are usually stored, the bulbs of the plants whose roots had been treated with the herbicide showed the highest percentage bulbs with apical cavities. In the second experimental

Table 1. Influence of chlorpropham (8 l/ha) on incidence of 'hollow noses' in hyacinth at various plant depths and bulb positions (up = top of bulb pointing upward; down = top of bulb pointing downward). n = 100.

Treatment	Diseased bulbs (in %)							
	1969/1970		1970/1971		1970/1971		1970/1971	
planting depth	4 cm	8 cm	4 cm		8 cm		12 cm	
planting position	up	up	up	down	up	down	up	down
1. untreated	0	0	–	–	0	0	–	–
2. pre-emergence spray	1.3	2.8	–	–	0	0	–	–
3. as 2 + spray after flowering	0	0	–	–	–	–	–	–
4. as 2 and washed in with 20 mm water	0	0	25.6	39.5	2.5	8.6	0	2.0
5. as 2 but applied to root	–	–	–	–	95.9	97.7	–	–
6. as 2 but applied in root zone + 15 mm water	75	85	–	–	–	–	–	–

Tabel 1. De invloed van chloorprofam (8 l/ha) op het ontstaan van 'holle neuzen' bij hyacint in afhankelijkheid van de plantmethode.

Table 2. Influence of chlorpropham and of the time of application on the incidence of 'hollow noses' and growth in hyacinth 'Delfts Blauw' (pot experiment, 8 bulbs/treatment).

Chlorpropham	Number of bulbs with cavities		Number of bulblets per bulb		Weight of bulb + bulblets in g		Dry weight of leaf mass at harvest per pot in g	
Time of application	*March*	*April*	*March*	*April*	*March*	*April*	*March*	*April*
Supply to the roots:								
20 ml/are	8	5	3.0	9.4	44.5	47.5	5.7	6.3
40 ml/are	8	8	5.6	8.8	45.8	43.9	6.5	5.6
80 ml/are	8	8	7.4	5.4	36.4	38.2	4.1	7.3
160 ml/are	8	8	9.3	4.1	39.1	35.5	4.8	5.8
Applied in leaf cylinder								
(5 ml 1 % solution)	8	8	3.3	6.5	29.1	47.9	6.6	6.4
Untreated	0		0.6		47.3		6.8	

Tabel 2. Invloed van chloorprofam en van het tijdstip, waarop het middel werd toegediend, op het ontstaan van 'holle neuzen' en op de groei van hyacint cv. 'Delfts Blauw' (potproef, 8 bollen/behandeling).

Table 3. Statistical evaluation of the results (Table 2).

Factor	Number of bulblets per bulb	Weight of bulb + bulblets
treatment	++	+++
time of appl.	+	n.s.
concentration	n.s.	+
interaction: time × conc.	+++	+++

+ = P 0.05; ++ = P 0.01; +++ = P 0.001; n.s. = not significant

Tabel 3. Statistische toetsing van de resultaten (Tabel 2).

year, the detrimental effect was stronger the shallower the bulbs had been planted. Bulbs planted upside down reacted more strongly. Spraying after flowering did not enhance the disease incidence (Table 1).

In the *pot* experiment too, chlorpropham was detrimental to the health of the plants; of 80 plants treated with chlorpropham, 77 bulbs with symptoms were harvested (Table 2). The statistical evaluation of the results is given in Table 3. The damage became more severe the higher the concentration of chlorpropham (Fig. 2). In contrast with the field experiment, application to the leaves by pouring a solution of the compound into the leaf cylinder caused damage to the bulbs. The dosage of weedkiller was, however, much higher in the pot experiment and penetration was promoted by the rather large quantity of the solution applied.

The number of bulblets increased in the treated material as compared with the untreated bulbs. When the compound was applied in March, the number of bulblets increased with increasing concentration, but after application in April this abnormal bulblet formation was already strongly stimulated by low concentration. Obviously the sensitivity to chlorpropham changes during the growing season. The decrease in number of bulblets at higher doses in April may be a result of increasing damage to the planted bulbs. So the development or outgrowth of adventitious buds may be prevent-

Fig. 2. 'Hollow noses' in hyacinth bulbs ('Delfts Blauw') caused by chlorpropham. From top to bottom resp. untreated, 0.2, 0.4, 0.8 and 1.6 ml/m^2 chlorpropham.

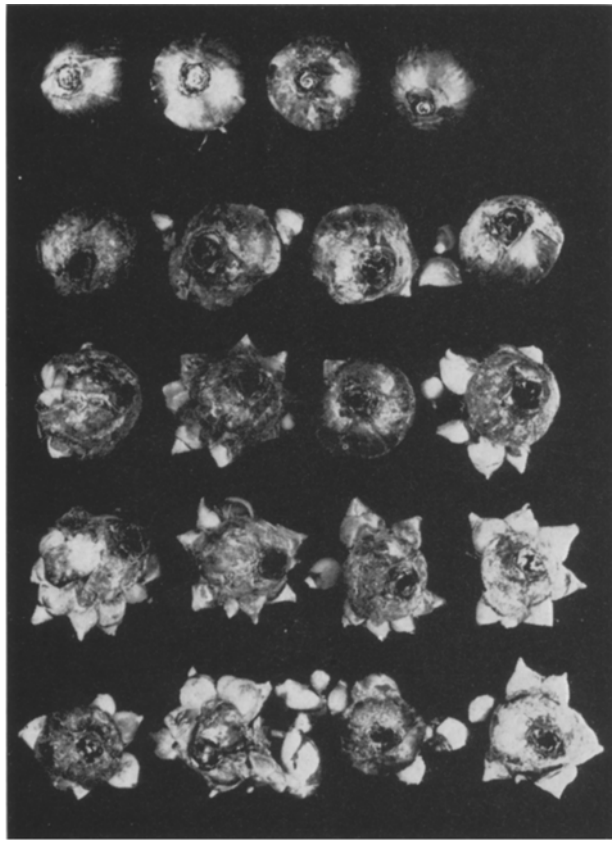

Fig. 2. 'Holle neuzen' in bollen van de hyacint 'Delfts Blauw' veroorzaakt door chloorprofam. Van boven naar beneden resp. onbehandeld; 0,2; 0,4; 0,8 en 1,6 ml/m^2 chloorprofam.

ed. This is also indicated by the bulb weight after harvest. There is a clear decrease in yield with increasing concentration of the April application. As far as leaf mass is concerned, there was no significant effect of the weedkiller on the dry weight of the leaves.

Discussion

The use of chlorpropham as a weedkiller in hyacinth cultivation carries some risk, but is not necessarily harmful, since no injury results if only the leaves and not the roots come into contact with the herbicide as shown by the absence of any ill effect of spraying after flowering in the field experiment of 1969/1970 (Table 1).

Under certain conditions, however, the weedkiller will reach the roots and cause damage. This occurs, for example on sandy soils with a very low content of organic matter. Penetration of the compound leads to greater damage when planting is shal-

low or is done mechanically, in which case all or part of the roots are present in the upper layer of the soil due to an aberrant position of the bulbs. Consequently, after emergence, the roots first grow upwards and may even reach the soil surface, which facilitates contact with the herbicide.

Samenvatting

'Holle neuzen' in hyacinten, veroorzaakt door het onkruidbestrijdingsmiddel chloorprofam

De laatste jaren wordt in hyacinten een onbekende afwijking gevonden. In de neus van de bol bevindt zich een grotere of kleinere holte, vandaar de naam 'holle neuzen' (Fig. 1). De bollen zijn niet rond zoals gezonde, maar aan één zijde, naar de bolschijf toe, afgeplat. In de rokken komen op die plaats talloze, glazige vlekjes voor, waardoor het weefsel een crème-achtige kleur heeft. Ernstig beschadigde bollen hebben een krans van klisters (Fig. 1 en 2). In het veld zijn vóór de oogst al afwijkingen in de bol te vinden. Wanneer beschadigde bollen in de herfst opnieuw worden geplant, ontstaan planten met verscheidene spruiten, zgn. bosjesplanten.

Het verschijnsel wordt vooral waargenomen op zeer humusarme duinzandgronden ('spuittuinen'). De meeste klachten over 'holle neuzen' zijn pas de laatste jaren ontvangen, min of meer sedert het ogenblik dat het machinaal planten sterk is toegenomen. In veldproeven en een potproef werd aangetoond, dat deze afwijking een gevolg is van het door de wortels opnemen van het onkruidbestrijdingsmiddel chloorprofam (Tabel 1 en 2). Het middel kan de wortels gemakkelijk bereiken op zeer humusarme grond en ook als de bollen ondiep of onregelmatig zijn geplant, zoals het geval kan zijn bij machinaal planten. De bol komt dan vaak niet met de bolschijf naar beneden gekeerd in de grond terecht. In dat geval groeien de wortels eerst omhoog in plaats van naar beneden, waardoor de kans op een rechtstreeks contact met het gebruikte herbicide sterk toeneemt.

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