

EFFECTS OF SELECTED HEAD BAGGING MATERIALS ON SEED YIELD, SEED GERMINATION, RHIZOPUS HEAD ROT, AND OUTCROSSING OF HA 89 INBRED

SUNFLOWER (HELIANTHUS ANNUUS L.)

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SUMMARY

Pollen control for germplasm maintenance and breeding in sunflower is accomplished by covering individual heads with various materials. Earlier work indicated highest yields were obtained when heads were covered with porous materials. The work reported in this paper was conducted to verify the effects of covering with porous materials on seed yield, seed germination, Rhizopus head rot, and outcrossing on inbred line HA 89. The highest overall yields were under Delnet¹, a commonly used plastic mesh bag (two year mean of 1277 kg/ha). Plants covered with cotton bags produced 1201 kg/ha which was nearly equal to plants covered with Delnet, followed by 1022 kg/ha yields from heads covered with polyester mesh bags. The nonbagged check averaged 473 kg/ha, and plants covered with heavy craft paper pollination bags averaged 391 kg/ha. The low yield from the nonbagged check reflects the damage to the heads due to sunflower moth and the subsequent infection by Rhizopus. The heads under polyester bags suffered the next highest Rhizopus infection. Those heads under paper had the least Rhizopus infection. A growout of 1985 seed and isozyme electrophoresis of 1986 seed determined outcrossing. Outcrossing was minimal except in seed from the nonbagged check. Cotton or Delnet bagging are the best materials for controlling pollination in sunflower under Iowa conditions. Paper bags detrimentally affected seed yield.

INTRODUCTION

Controlling pollination in sunflower breeding or germplasm maintenance is necessary because of the outcrossed nature of the species. Individual heads are covered with various materials or a number of plants are caged to exclude pollinators. Pollination is by hand on individually covered heads or by insect pollinators in cages.

Workers have used various materials to cover sunflower heads. Fick (1976) quoted Gundaev as using cloth bags with a density of 20 threads/cm for isolation bags in the USSR. US workers have used cotton bags, Delnet bags made of plastic netting, and paper (Fick, 1976).

The effects of some bagging materials on seed production was

1. Reference to commercial brand names is not an endorsement of that product by USDA-ARS.

studied by Putt (1941). He used two different cotton bags (34 and 50 threads/cm), tiffany, and paper bags in a seed production trial. Putt reported an average seed set of about 14, 27, 11 percent for the cotton, tiffany, and paper bags, respectively. The seed set of the open pollinated check was 66 percent. He felt that pending a progeny check, the paper bags were adequate for his use. Kalton (1951) found the poorest seed set under craft paper pollination bags, followed closely by seed set obtained under 11.3 kg. paper grocery bags. He had the highest seed set under cheese cloth, followed by heads under muslin with 34 threads/cm, and then by muslin with 50 threads/cm. He concluded that the muslin bags best suited his use, as the cheese cloth allowed too many outcrosses, and paper severely reduced seed set and was not durable enough. He found no effect on seed germination due to bagging materials.

This paper reports evaluation of four sunflower head covers on seed yield, germination, Rhizopus head rot (incited by Rhizopus spp.), and outcrossing in sunflower inbred line, HA 89.

MATERIALS AND METHODS

HA 89 inbred seed was planted at Ames, IA in 1985 and 1986. Single row plots 6.1 m long and 0.9 m apart with about 50,000 plants per hectare were used in this study. Each treatment was replicated four times. Heads of plants at late bud were covered with the following materials: craft pollen bags, Delnet bags, unbleached cotton bags (24 threads/cm), polyester bags (about 8 threads/cm), and an uncovered check. Plants were allowed to mature with the bags in place. Physiologically mature plants were harvested, dried at 32°C, threshed and seed yield recorded.

Heads from the 1985 harvest were scored for Rhizopus infection prior to threshing. A growout of 1985 seed the following season allowed outcrossed plants to be counted. The number of outcross progeny identified by locus Mdh1 assays determined outcrossing in 1986 seed.

Percent germination was determined from seed placed in a germination cabinet with alternating 12 hour periods of 21°C and 31°C temperatures and 16 hours of light for seven days.

A total of 220 individual seeds from each treatment were assayed for allelic variability at the Mdh1 (malate dehydrogenase, Mdh EC 1.1.1.37) locus. Seeds were soaked over night and cut into quarter sections. Sections included both cotyledon and embryo tissue were ground in microtubes with extraction buffer. Extraction buffer consists of the following: 1.0 M Tris, 0.001 M Polyvinylpyrrolodine MW 40,000, 0.016 M Diethyldithiocarbamic acid - sodium salt, 0.011 M Ascorbic acid - sodium salt, 0.10 M Sodium tetraborate (Borax). Concentrated HCl was added to buffer to 7.8 pH. About 0.15 ml of this solution was placed in a 0.5 ml polyethylene microtube, and either stored frozen until use or used immediately. The AC (amine-citrate) buffer system (Clayton and Tretiak, 1972) was used. Electrophoresis was conducted at 70

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Table 1. Seed yield of HA 89 inbred sunflower line under selected head bagging materials.

Bagging	1985 yield KG/HA *	1986 yield KG/HA *	2 yr. mean KG/HA
Cotton	1819 a	583 ab	1201
Delnet	1795 a	758 a	1277
Polyester	1738 a	306 bc	1022
Paper	640 b	142 c	391
Not bagged	932 b	14 c	473
CV %	16.11	17.10	

* Yields followed by unlike letters are statistically different (p=0.05) (LSD).

Table 2. Mean score for *Rhizopus* infection of HA 89 inbred sunflower heads covered with selected head bagging materials, 1985.

Bagging	<i>Rhizopus</i> score* ¹
Cotton	3.2 c
Delnet	2.7 cd
Polyester	4.4 b
Paper	1.7 d
Not bagged	6.1 a

* Numbers followed by unlike letters are statistically different (p=.05) (LSD).

¹ Infection score on a 1 to 10 scale.

Table 3. Seed germination of HA 89 inbred line seed produced under selected head bagging materials.

Bagging	germination * %
Cotton	86.5 a
Delnet	80.3 a
Polyester	71.3 a
Paper	83.3 a
Not bagged	40.3 b

* Numbers followed by unlike letters are significantly different ($p=0.05$) (LSD).

Table 4. Number of phenotypically variant plants from 1985 seed from HA 89 inbred sunflower heads covered with selected bagging material.

Bagging	number of HA 89 type plants	number of outcrosses	Frequency of variant plants
Cotton	139	0	0.000
Delnet	132	0	0.000
Polyester	108	1	0.009
Paper	111	0	0.000
Not bagged	101	14	0.122

Table 5. Number of of outcross heterozygotes observed at locus Mdh1 among progeny of bagged HA 89 heads. A total of 220 progeny wer assayed for each bagging material used.

Bagging	Number of outcross heterozygotes	Frequency of outcross heterozygotes
Cotton	2	0.009
Delnet	3	0.014
Polyester	0	0.000
Paper	2	0.009
Not bagged	23	0.104