# INSECT TRIPPING IMPROVES SEED YIELD OF COMMON BEAN

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## Introduction

Several potential insect pollinators forage common bean flowers in California fields. When insects such as honey, bumble and carpenter bees forage bean flowers, pollination could be enhanced and seed yields increased, even though it is assumed that self-pollination in common beans proceeds at a high enough rate for pollination not to be a limiting factor. That bean flowers self pollinate in the absence of pollinators does not establish that it is of sufficient efficiency to maximize seed yield potential. More precise information needs to be obtained on common bean pollination requirements and the possible value of pollinating insects. The objective of this study was to determine the effect of insect tripping on seed yield of common bean lines.

## Materials and Methods

The effect of mechanical tripping by bees and bumblebees on seed yield of common bean was studied during a period of four years (1991-1994) on the Agricultural Experiment Station University of California Riverside. Field experiments were carried out using 4 common bean lines. Plant characteristics of these lines included two modern commercial cultivars, a determinate bush 'Linden' and indeterminate 'Pindak' an indeterminate bush line (PI164778) and an old commercial indeterminate-vine Ferry Morse 53 (FM 53). In each year (except in 1991), a factorial design in a randomized complete block experiment with four replicates was used. Bean plants of each cultivar were grown under three treatments: 1) in open visitation by insects or 2) in insect-proof cages (1.52 m wide by 2.0 m long by 1.20 m high) and 3) in the same sized cages with bumblebees. All pods produced by bean plants within the harvested area were collected and counted, and seed yield was determined.

## Results and Discussion

Bee tripping of bean flowers increased seed yields by up to one third, depending on cultivar and year of evaluation. Results from individual analysis of variance revealed that bean lines were significantly ($P \leq 0.01$) different for seed yield but treatment effects were not consistent across the 4 years of evaluation (Table 1). The old cultivar FM53 and PI164778 did not show a clear trend for seed yield response to insect pollination across years. In contrast, the modern cultivars, Linden and Pindak, showed a more defined and positive tripping effect on seed yield production. Data from 1991 indicated that Pindak had 27% higher seed yield under the open than the caged treatment. In the second year (1992), Linden had similar seed yield in both the open (131.8 $g/m^2$) and caged with insects (132.8 $g/m^2$) treatments; these seed yields were 13% higher than that of caged plants without insects. In the same year, Pindak had a 9% increase in seed yield when plants were visited by insects, either in the open (106.3 $g/m^2$) or in the caged (104.0 $g/m^2$) treatments. The response of Linden to bee pollination was even greater in a fourth year of evaluation (1994) as plants produced on average 35% higher seed yield in the open or caged with insects treatments, 151.8 $g/m^2$ and 143.4 $g/m^2$, respectively than in the caged treatment.

These observations indicated that bean cultivars such as Linden and Pindak responded positively to bee tripping in 1992. Seed yield increase due to bee tripping was also observed in 1991 for Pindak and in 1994 for Linden. Hence, bee tripping of flowers of field grown plants was important for seed yield increase in Linden and Pindak in two years out four. As far as we are aware, this is the first report of the benefit of insect tripping of common bean flowers on seed yield under field conditions. Clearly, this research needs to be repeated in areas of commercial bean production. It might be worthwhile to extend this research to bean production areas not only of California but to other states, particularly where commercial seed yields have reached a maximum through crop management.

Table 1. Mean values for seed yield of four common bean cultivars grown under open visitation by insects and caged treatments during four years at Riverside, CA.

| | Seed yield ($g/m^2$) | | |
|---|---|---|---|
| | Open | Caged | Caged+bees |
| | | 1991 | |
| FM 53 | 219 a* | 128 b | ---- |
| PI 164778 | 119 a | 71 b | ---- |
| Linden | 129 a | 129 a | ---- |
| Pindak | 101 a | 74 b | ---- |
| LSD * | 18 | | |
| | | 1992 | |
| FM 53 | 36.1 c | 84.8 a | 61.6 b |
| PI164778 | 83.0 a | 85.2 a | 81.1 a |
| Linden | 131.8 a | 114.9 b | 132.8 a |
| Pindak | 106.3 a | 95.6 a | 104.0 a |
| LSD | 14.2 | | |
| | | 1993 | |
| FM 53 | 192.4 a | 189.4 a | 196.2 a |
| PI164778 | 67.0 c | 140.3 a | 114.5 b |
| Linden | 120.5 b | 141.2 ab | 147.6 a |
| Pindak | 98.1 a | 96.3 a | 105.6 a |
| LSD | 21.4 | | |
| | | 1994 | |
| FM 53 | 289.8 a | 171.4 b | 141.7 c |
| PI164778 | 165.6 a | 133.5 b | 124.2 b |
| Linden | 151.8 a | 96.6 b | 143.4 a |
| Pindak | 139.0 a | 128.6 ab | 101.6 b |
| LSD | 27.5 | | |

* Within rows, means followed by the same letter are not significantly different at $P \leq 0.05$ with LSD test.