

EFFECT OF DEFOLIATION ON YIELD, MATURITY AND
SEED SIZE OF WHITE BEANSG.R. Ablett and A.W. Schaafsma
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This project was initiated as part of a larger research study which is attempting to define the relationship between the loss of photosynthetic area and the subsequent agronomic response in white beans (*Phaseolus vulgaris* L.). The objective of this study was to determine the recovery capacity of white beans to 7 levels of defoliation when imposed at 4 separate growth stages. The rationale was that the response would mimic the actual response to a single-event stress caused by insect defoliation, herbicide burn, frost, hail or any other stress which would decrease the total photosynthetic area. As such, this information would provide a useful base for recommendations to growers faced with management decisions prompted by loss of leaf area.

The experiment was set up in 1988 and 1989 as a factorial arrangement of a R.C.B.D. with 4 replications. The experimental unit consisted of 4 rows, 4 m long with 60 cm row spacing. The trial was seeded on June 12 and June 26 in 1988 and 1989 respectively. The cultivar used was Ex Rico 23, a type II white bean adapted to the major bean growing areas in Ontario. Seven levels of defoliation (0%, 17%, 34%, 50%, 67%, 83% 100%) were manually imposed at 4 different growth stages (early vegetative, late vegetative, flowering, mid-pod fill). The levels of defoliation were obtained by dividing each trifoliate leaf into 6 sections using the mid-vein as a dividing line for each leaflet. This allowed for the removal of one-sixth section of each trifoliate leaf from 0/6 up to 6/6. All plants in all rows were defoliated according to treatment designations. Measurements were taken on the centre 2 rows using a central 2.5 m section. Yield was recorded in grams and reported in kg/ha at 18 g kg⁻¹ moisture. Maturity was measured in days from planting until ripening. Seed size was estimated by averaging the seed weight in grams of two 100-seed samples for each plot. The results were subjected to analysis of variance. In each year the stage x level of defoliation interaction was highly significant. Polynomial equations (3rd order) were fit to the data for the 7 levels of defoliation at each growth stage, each year.

In 1988, slight yield reductions (approximately 10%) occurred for levels of defoliation up to 50% for each growth stage with differences among growth stages negligible. As the level of defoliation increased from 50-100% the effect on yield also increased. This effect differed among growth stages and was the greatest for the mid-pod fill stage, followed by the flowering and early vegetative stages. The response at the late vegetative stage appeared to be an anomaly as yield trended slightly upwards at higher levels of defoliation. At maximum levels of defoliation, yield levels were reduced to a maximum of 60% at the mid-pod fill stage, 42% at the flowering stage and 25% at the early vegetative stage.

The effects of defoliation on maturity were minor up to 70% defoliation in 1988. Beyond that level, maturity was delayed to a maximum of 10 days at the early and vegetative growth stages and up to 25 days at flowering.

The effect on defoliation on seed size was also minimal with a slight reduction at the highest levels of defoliation when imposed at the flowering and mid-pod fill growth stages.

In 1989, the yield response to defoliation differed from that recorded in 1988. With defoliation level up to 50% only, no reduction in yield occurred at the early and late vegetative growth stages, however, yield was reduced quickly at defoliation levels beyond 50% to a maximum of 40% at early vegetative and 67% at the late vegetative growth stage.

For defoliation at flowering and mid-pod fill yield loss was approximately 25% at the 50% defoliation level. Again, rapid yield declines occurred at higher levels of defoliation at the flowering growth stage to a maximum of 75% at 100% defoliation. The response to defoliation at the mid-pod fill stage was essentially a straight line reduction, to a maximum of 59%.

As in 1988, the effect of defoliation on days to maturity was negligible for all growth stages up to a 70% defoliation level. Thereafter, a 10-day delay in maturity occurred at the vegetative growth stages, no effect was obtained at flowering and a slight acceleration in days to mature occurred at the mid-pod fill stage.

The response of defoliation on seed size was again small in 1989 as it was in 1988 and was only apparent at defoliation levels beyond 60%. This response was manifested in a very slight reduction in seed size for the vegetative and flowering growth stages with a somewhat greater reduction for the mid-pod fill stage of defoliation.

Overall, the response of white bean to defoliation was different each year. This difference, however, was usually only at the higher levels of defoliation.

Minor yield reductions were recorded at the vegetative growth stages up to 50% defoliation. These yield reductions were somewhat greater when defoliation was imposed during reproductive growth. No major effects on maturity and seed size were obtained in either year for defoliation up to 70% at any of the 4 growth stages.

In conclusion, the results obtained indicate that the white bean has the ability to almost fully recover from a fairly severe loss of photosynthetic area (approximately 50% or less) when imposed as a single-event stress. The ability to recover from a greater stress (>50% defoliation) will differ as a result of year effects and as a result of the growth stage at which defoliation occurred.