Section I: mites and sap-sucking insects

BINOMIAL SEQUENTIAL DECISION PLAN FOR TWOSPOTTED SPIDER MITE ON PINTO BEANS

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We used Wald's Sequential Probability Ratio Test (SPRT) to derive binomial (presence:absence) decision plans for spider mite management (Tetranychus urticae) on pinto beans with foliar applied miticides. Based on our earlier field studies, we adopted 20 to 68 mites per leaf as the economic injury level for beans valued at $30/cwt and for mite control costs ranging from $8 to $28/acre. Economic thresholds were computed with an empirical equation that forecasts mite population increase in bean fields as a function of current mite density ($\overline{x}_t$) and expected degree days ($DD_{10\,°C}$):

$$\overline{x}_{t+1} = \overline{x}_t\, e^{0.02085\, DD_{10\,°C}}$$

($n = 14$, $P = 0.0001$, $r^2 = 0.969$). Here the realized rate of mite population increase (0.02985) was derived by linear regression between $\ln(\overline{x})$ and $DD_{10\,°C}$. Given degree-day accumulations typical of southern Idaho during mid-July through mid-August and assuming a one week time delay between field scouting and miticide application, the model predicts that foliar application of miticides is justified when densities reach 5 to 18 mites per leaf; if mites are not controlled at these densities, infestations will increase within one week to the economic injury level of 20 to 68 mites per leaf. Economic thresholds were re-expressed as the proportion of mite infested leaves (P_i) with the model

$$P_i = 1 - \exp(-0.29916\overline{x}^{0.57589})$$

($n = 34$, $P = 0.0001$, $r^2 = 0.902$), where $\overline{x}$ is mean mite density per leaf. Alternative models based on the Poisson distribution were less accountable ($r^2 = 0.794$) while those based on the negative binomial could not be fit to the data set because a common k could not be found.

As a compromise between sample size and accuracy, we adopted the following parameters for the decision plan: (1) economic threshold (Wald's m_2 value) = 63% mite-infested leaves, which is equivalent to 8 mites/leaf; (2) lower limit of non-economic infestation (Wald's m_1 value) = 43% mite-infested leaves, which is equivalent to 3 mites/leaf; (3) α and β (probability of false spray decision and failure to spray) = 0.1 and 0.05, respectively. Implementation in the field involves visually inspecting randomly selected leaves (alternately chosen from the upper, middle and lower canopy strata) during plant growth stages prior to pod formation and tallying leaves as either infested or uninfested. Our field data suggest that mite infestations which do not develop until pod formation or later plant growth stages have little economic impact on yield quantity or quality.

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We have yet to evaluate the accuracy of the decision plan in the field. Limited comparisons during 1990 did show that field scouting time required for binomial sampling declined as a curvilinear function of mite density while scouting time required for absolute counts increased as a linear function of mite density. The time advantage of presence:absence sampling was greatest when mite densities exceeded 10 per leaf.

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SEQUENTIAL DECISION CARD

Spider Mite Control in Commercial Dry Beans

Field/unit ID: _____ Variety: _____ Date: _____

Number of leaves examined	DO NOT SPRAY if tally is less than	RUNNING TALLY: no. leaves with ≥1 mite	SPRAY if tally exceeds	Number of leaves examined	DO NOT SPRAY if tally is less than	RUNNING TALLY: no. leaves with ≥1 mite	SPRAY if tally exceeds
1		_____		16	5	_____	12
2		_____		17	6	_____	12
3		_____		18	7	_____	13
4		_____		19	7	_____	13
5		_____		20	8	_____	14
6		_____		21	8	_____	14
7	1	_____		22	9	_____	15
8	1	_____	7	23	9	_____	15
9	2	_____	8	24	10	_____	16
10	2	_____	8	25	10	_____	16
11	3	_____	9	26	11	_____	17
12	3	_____	9	27	11	_____	17
13	4	_____	10	28	12	_____	18
14	4	_____	10	29	12	_____	18
15	5	_____	11	30	13	_____***	19

*** If tally is between 13 and 19 after 30 leaves have been inspected, the infestation is borderline; re-check field in 2 to 4 days

▒▒▒▒ designates that a decision is not possible; continue sampling