Innovaciones Tecnológicas Agropecuarias S.A.

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Final Report

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AGRICULTURAL PRODUCTION AND HEALTH PROGRAM

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Our company, owned in its majority by INTA and the balance by organizations within the Rural Sector, has as its priority the development of technologically-oriented business opportunities which are of relevant application within the agricultural, husbandry, ag-food and ag-industrial sectors.

The consummation of business implies the summation of a series of activities and events of various kinds, an extremely important component being the due diligence conducted prior to commencement of commercial activities *per se*, particularly when innovative processes are involved.

INTEA has participated on numerous occasions in such processes sponsored by the Secretariat of Science, Technology and Innovative Production. On this occasion INTEA has participated with the conviction that pooling expert technical knowledge and adequate facilities is of strategic importance for the successful introduction of a new diagnostic tool oriented toward the development of a product/service that can be acquired by the diverse actors that intervene in the soy value chain.

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Cost/benefit analysis of applying the immunoassay strip diagnostic method

As mentioned above this new SBR detection method would have the following advantages:

a. Permits SBR detection at an earlier stage of pathogen development.
b. Allows more time to organize the logistical aspects of chemical control.
c. Facilitates precise diagnostics thus reducing “preventive applications”.
d. Contributes to determining the optimal time for chemical control, with the aim of minimizing crop yield loss.

Considering the immunoassay strips’ expected attributes, we attempted to quantify the specific benefits of this methodology in the context of conventional SBR management practices and know-how.

The new diagnostic technique does not alter nor invalidate conventional field sampling methodology and guidelines established by INTA; the only aspect that varies (or is

added) is the use of the immunoassay strips in situations where the symptomology is doubtful or difficult to observe even under a magnifying lens (i.e. light and incipient infections). Monitoring should intensify when rust is evident at a distance of 150 kilometers from the reference point. Monitoring should not be conducted in function of dates nor the crop's phenological stage, because this tends to encourage totally preventative fungicide applications which, in any case, do not dispense with the need for more intensive monitoring when approaching rust spores are confirmed.

When there is a severe rust attack in nearby areas (150 km) and conducive climatic conditions (more than 6 hours of dew combined with moderate temperatures, 20-25°C) the risk of high economic losses can arrive within 7 to 10 days. For this reason, it is important to quantify the "time factor" by making a precise diagnosis as early as possible, to facilitate recommendations and operational aspects related to chemical control, as well as to permit good control practices (i.e. taking only the measures which are necessary).

Interpretation of the immunoassay strip method's advantages

Argentine soy production occupies 16.5 MM hectares (41.75 MM acres) and not less than 60% of the cultivated area is exposed to rust attack. The average yield in Argentina is 2.3 tons per hectare, though in the Pampa region the yields can exceed 3 tons per hectare, while in the NE region near Brasil, Paraguay and Bolivia, the averages are in the 1.5-2.0 ton/hectare range.
Based on recent yield-loss trials conducted by INTA experimental stations, SBR's average impact on yield is 0.46 tons per hectare.

To quantify the possible benefits resulting from immunoassay strip usage for early SBR detection, specifically to accelerate the detection and diagnosis of a rust attack and thus have greater time for the logistics involved in chemical control, we worked under the following 4 assumptions:

1. Strips would be used on only half a million hectares (3% of total area or 5% of affected area (see Table 1);
2. That on said area advanced technologies are routinely employed and thus greater than average yields >3 ton/ha are typically obtained;
3. That immnunotrip usage would be instrumental in avoiding a 5% yield loss in advanced crop-cycle areas (equivalent to about one third of average yield loss);
4. That immnunotrip usage would be instrumental in avoiding a 10% yield loss in early crop-cycle areas (equivalent to about two thirds of average yield loss);

The above assumptions suggest two probable scenarios.

In the first scenario, rust attacks at a late stage (R3 or later) and the strip method (for all the foregoing reasons) contributes to saving 5% of the yield, which is equivalent to a potential loss of 0.15 ton/ha. If this occurred on half the 500,000 hectares total area where strips are used, it would imply a savings of 37,500 tons valued at $150/ton, thus representing total savings of $5.62 MM.

In the second scenario, rust attacks at an early stage (R1 or before) and early detection resulting from the strip method contributes to saving 10% of the yield (i.e. 0.3 ton/ha.); again we assume that this occurs on half the 500,000 hectares in question, thus implying a savings of 75,000 tons valued at $150/ton and total savings of $11.25 MM.

Pursuant to the data presented in Table 1, the benefits gained in the above two scenarios would be achieved by incurring an additional cost (through immnostrip usage) of approximately $44,500.

Therefore, based on the variables and assumptions outlined above, the use of immunoassay strip methodology complemented with conventional methods of diagnosis and control would generate a profit in the range of US$5.6 to 11.2 million dollars.

Thus, the ballpark cost/benefit ratio resulting from immunoassay strips usage in the two above mentioned scenarios would be 1:126 in the first case, and 1:252 in the second case. Additionally, if - thanks to precise diagnoses on the half-million hectares subjected to strip monitoring - preventative fungicide applications were to be reduced on a mere 2% of the area (i.e. 10,000 hectares), soy producers would save an extra $550,000 given that SBR fungicide costs on average $55 per hectare.

Conclusions

- The use of strips as a complementary method for SBR diagnostics has satisfactorily achieved validation trial objectives, pursuant to established protocols.
- It has been proven that the lateral flow strips permit identifying the disease directly in the field in a rapid, simple and practical manner; results are qualitative, i.e. they determine the presence or absence of SBR, but do not measure the intensity of the attack.
- The trials that were conducted permit affirming that the lateral flow strips do not cross-react with diseases that can be confused with soybean rust, such as *Cercospora sojina*, *Cercospora kikuchii*, *Xanthomonas campestris* pv *glycinea*, *Peronospora manshurica*, *Septoria glycines* y *Pseudomonas savastanoi* pv. *Glycinea.*

- The strips have proven that they possess the capacity to detect rust even when chlorotic lesions on the leaf tissue are very difficult to distinguish under a magnifying glass, which permits anticipating and facilitating the diagnosis with precise results, and favors JUST IN TIME logistical preps for chemical control.
- The economic benefits derived from immunoassay strip diagnostics are likely to be several orders of magnitude greater than the associated costs.
- The simplicity of the strip method does not require high level experts nor additional equipment, though it is recommended that they be used by personnel with adequate technical training.
- Within the ag-industrial soy supply chain, the principal and most direct beneficiaries of lateral flow strip diagnostics will be the agents who operate “technical assistance networks”, companies who offer fungicide application services, and the soy producers themselves.
- The strip was not developed to substitute other conventional monitoring methods, is an additional and complementary SBR diagnostic tool, and the strip results should be interpreted in the context of other information obtained both in the field and lab.