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Phenology: A Valuable Tool in Crop Farming

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The global human population goes hand in hand with food supply which is heavily dependent on crop production on a large scale. Nowadays, the above-mentioned production, i.e., crop farming which is an important subset of agriculture, faces a lot of problems due to various predictable and unpredictable factors, such as political instability, inflation, reduced availability of agricultural land and climate variability. The situation is getting worse as time passes and a large part of the responsibility could be attributed to the indifference of several of those in power. Nevertheless, there is still time to take action, applying effective control and preventive measures, among others, which do not cost much. One such measure is phenology.

Phenology, a branch of science deriving from the two Greek words *phaino* (to appear) and logos (''reasoning, or rational thought''),[1] is dealing with the study of periodic biological events in plants and animals, as affected by the environment, particularly temperature changes driven by weather and climate.[2] To successfully carry out phenological studies, the person in charge, who may be volunteer, ought to be methodical, taking into account that the phenological stages which are single points during development, such as full bloom, must be defined exactly for comparison purposes. In this regard, another important parameter of phenology, the phenological phase (i.e. phenophase), which is the time between two adjacent phenological stages[3] requires an exact definition as well. Phenological observations *in situ* (ground-based), one of the first steps in the implementation of phenology, do not require costly equipment, as the "instrument" for monitoring the environmental conditions is the plant itself. In this way, remarkable stages of plant growth whose start dates can be determined to a specific day can be observed.[4]

Apart from the traditional ground-based phenological observations, recently new technologies for monitoring plant phenology have been developed such as near-surface cameras and satellite sensors. The results from the application of these technologies cannot be considered satisfactory up to now, since large discrepancies between them and the traditional phenological observations exist[5] implying thus their greater effectiveness.

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Phenological observations, especially those *in situ,* play a crucial role to crop farming. The knowledge of appearance dates of crop phenophases, which may vary from year to year because of the environmental variability, substantially contribute to farmers' awareness to proceed rationally choosing the right time, concerning necessary cultivation techniques such as fertilization, irrigation and crop protection operations. Also, the aforementioned knowledge can help the selection of the most suitable species or varieties of crops in certain regions.[6] Matching crop phenology to the surrounding environment seems to be promising for increasing acclimation, implementing timely agricultural applications, and ultimately enhancing production efficiency.[1] In this way, saving money and time, combining with a better outcome and improved sustainability is feasible.

Conclusions

Crop farming can gain a lot from the implementation of phenology, leading farmers to adopt more effective measures to sustain both their cultivations and the environment, increasing in parallel their income. In the future, with the progress of the remote phenological observation and the availability of more relevant data, the discrepancies between traditional and remote phenology are expected to be reduced, a situation which will probably be beneficial for the farmer.

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