SUNFLOWER CULTIVAR EVALUATION:

A collaborative effort to ensure efficient seed production

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The profitability of sunflower seed production is under constant pressure and making a wrong decision regarding which cultivar to grow, can result in inefficient use of inputs such as fertiliser. An expected profit can easily turn into a loss. Consequently, cultivar evaluation trials are conducted to investigate efficiency.

Environmental influence

Not all sunflower cultivars are similar in their response to the environment. Some will perform well in a particular environment, while others will perform poorly. The opposite might be true in another environment. This phenomenon is well-known in crop science and is referred to as the cultivar-environment interaction.

A second key characteristic of cultivars is yield stability. The yield of an unstable cultivar has a high variation, while that of a stable one has a low variation in similar environmental conditions.

Due to these phenomena, the yield difference between cultivars at a particular locality often exceeds 0,5t/ha^{-1}. This difference has a large impact on the profitability of a sunflower crop, considering that the national mean yield is approximately 1,2t/ha^{-1}.

The aim of the cultivar evaluation programme is to enable farmers to select well-adapted cultivars for their particular conditions and to ensure the highest possible efficiency in input utilisation, as well as the soil and climate where the crop is grown.

Seed industry participation

Local evaluation of sunflower cultivars commenced in the 1975/76 season and has continued ever since. Initially, the evaluation was almost exclusively handled by the Department of Agriculture. In the course of time, seed industry participation increased, to the current point where most of the field trials are conducted by five seed companies.

Cultivar evaluation trials are costly, as they require relatively high management and labour inputs. Despite the high cost, a continuous process of cultivar evaluation is justified. Between 25 and 33% of commercially available cultivars is annually replaced with new entries. The yield performance of some cultivars deteriorates over time, which warrants an annual evaluation process. If a cultivar with a unique quality, such as an extremely high oil content, appears on the market, it will be independently identified and confirmed by the evaluation process.

A typical field trial has about 20 cultivar entries, which are planted in plots consisting of four rows, spaced 0,90m apart and 8 to 10m long. Results from these trials are analysed statistically and the layout adheres to the rules of statistics, such as the requirement for randomisation and replication. About 30 trials are conducted annually in the main production areas, on commercial sunflower and experimental farms. The aim is to conduct field trials on similar soils and environments where commercial sunflower is grown.

Five South African seed companies partake in the trials and the majority

An example of cultivar plots consisting of four rows, in a typical field evaluation trial.

of field trials are conducted by them. For each cultivar entry, at least one trial needs to be conducted by the participating company. The Agricultural Research Council Grain Crops Institute (ARC GCI) plans the trials, packs the seed according to the trial plans and distributes it to the various participants.

Results analysis and presentation

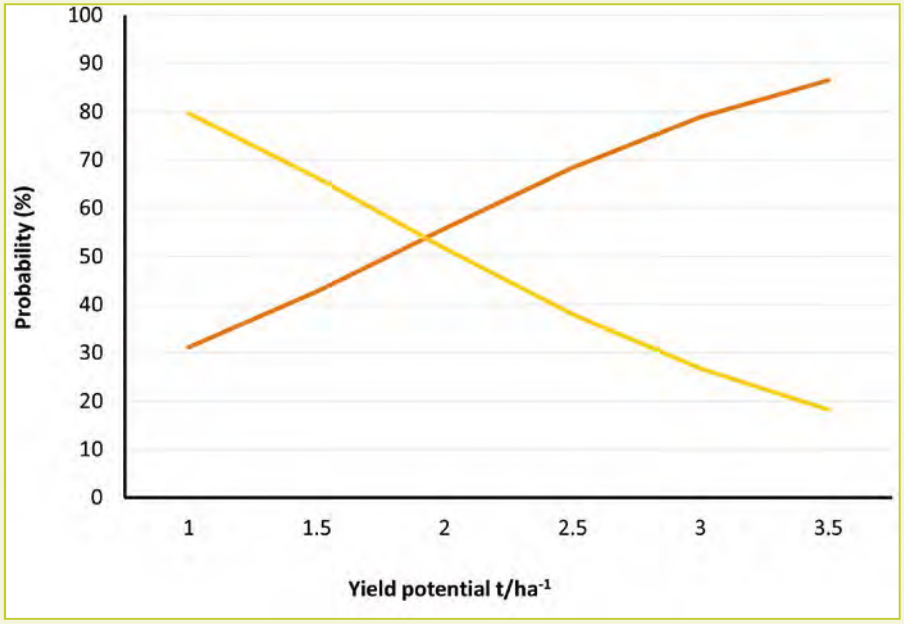
After harvesting the field trials, yield results are sent to the ARC GCI. An analysis of variance is performed for each trial to determine its reliability. Results from reliable trials are pooled and the yield probability for the various cultivars is calculated through regression analysis. The yield probability is simply the probability of a particular cultivar to achieve an above-average yield at a particular yield potential.

The yield potential is reflected by the long-term mean yield of a particular field or environment. Due to their experience, farmers are usually good judges of yield potential. The yield probability accounts for the cultivar-environment interaction as well as yield stability. Yield probabilities are then summarised for a range of yield potentials in a table format. *Table 1* is an excerpt of the 2013/14 results.

The yield probability table, which is published annually, serves the purpose of cultivar recommendation. A farmer can easily select one or more cultivars with high probabilities for sunflower yield potential in his particular environment and place an order with the relevant company.

Table values can also be graphically displayed as presented in *Figure 1*, where the yield probability of only two cultivars over a range of yield potentials is shown. These two cultivars clearly demonstrate the cultivar-environment interaction. The yield potential of a cultivar should be above 50% before it becomes a meaningful option. Occasionally, cultivars with no environmental interaction are discovered. Those with an above-average yield are popular due to their superior performance, despite the seasonal rainfall.

Figure 1: The yield probability of two cultivars, indicating the cultivar-environment interaction.



Note: *For a yield potential below 1,9t/ha^{-1}, the yellow cultivar will be the obvious choice of the two, while the opposite is true for potentials above this value.*

Table 1: Yield probability (%) of sunflower cultivars evaluated in 2013/14.

	Yield potential (t/ha^{-1})		
Cultivar	**1**	**2**	**3**
Agsun 5264	42	33	25
Agsun 5270	31	**56**	**79**
Agsun 5271	30	50	**70**
Agsun 5278	34	47	**60**
Agsun 5279	38	49	**61**
Agsun 8251	21	**53**	**84**
CAP 4000	47	42	37
PAN 7033	47	46	45
PAN 7049	**81**	**77**	**71**
PAN 7057	**64**	**55**	45
PAN 7080	**51**	**73**	**88**
PAN 7098	30	59	**84**
PAN 7100	**87**	**78**	**62**
PAN 7095CL	44	**57**	**69**
PAN 7101CL	27	29	32
PAN 7102CLP	**80**	**52**	27
PHB 65A25	43	36	31
PHB 65A70	**56**	44	34
SY 4200	39	36	33
SY 4045	**89**	41	8

Trial results are not limited to the yield, but other characteristics are also measured. Growing season length is an important cultivar characteristic as well as the seed oil and protein content, which are measured for most trials. No statistical analyses are completed based on these results and only mean values are reported.

The South African cultivar evaluation programme is probably unique, considering the participation of seed companies, the analysis method and presentation of the results. In the USA, for example, results of individual trials are published without statistical analysis, which accounts for the cultivar-environment interaction and yield stability. In this respect, South Africa's sunflower industry is probably a step ahead of several countries abroad.

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