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RANDOM SAMPLE LAYER TESTS AND THEIR IMPLICATIONS FOR POULTRY BREEDING

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DECLINING INTEREST IN RANDOM SAMPLE TESTING

Random sample layer testing is a contentious issue. About the only point on which general agreement will be reached is that the most important objective of such tests is to provide unbiased comparisons to poultry farmers of the performance of commercial poultry stocks. It therefore seems somewhat ironic, given that it is the farmers who are the main consumers of test results, that it has been the breeders who have been instrumental in initiating tests and who have taken the greatest interest in the manner in which the tests have been conducted.

The United States was the first country to conduct random sample testing on a large scale with Dickerson (1962) documenting the history of their development, and the fundamental techniques required for their operation. Hawkins (1972) showed a total of 22 different tests in the USA and Canada in 1965, but this number rapidly dwindled such that only 5 tests were listed in the 1978 Report of Random Sample Egg Production Tests prepared by the USDA, which I suspect was the last such combined report produced. The number of breeders entering the USA tests was as high as 133 in 1960 according to Hawkins (1972), but again this had declined to just 14 by 1978.

A similar decline in random sample testing has occurred in Australia since, at the time of writing, there are only three tests which are operated by Departments of Agriculture in New South Wales, Victoria and Tasmania. The current Victorian test is the last to be conducted in the existing facilities and may well be the final one in that state. Tests that have now ceased were formerly operated in South Australia (until 1984), Queensland (until 1973) and in Western Australia (until early 1970's).

In recent years attempts have been made towards the standardisation of different test procedures, mostly to facilitate the preparation of national random sample test summaries. Some worthwhile progress was made in that all tests operating at the time were able to agree at least on the age at which tests commenced (18 weeks), and the duration of tests (to 78 weeks), as well as on a number of more minor procedural matters. Issues such as cage densities, sample sizes and replicate sizes are largely determined by

the existing facilities and less amenable to standardisation. Two national summaries have been published covering the periods 1976-80 (McDonald and Bruce, 1981) and 1980-82 (McDonald, 1984).

WHO ARE THE AUSTRALIAN LAYER BREEDERS?

The corporate structure of the primary layer breeders in Australia has been dynamic over the past 10 years, even when consideration is limited to those companies that have attempted to supply a national rather than a regional market. The Scientific Poultry Breeding organisation was absorbed by the Tegel company who formerly had concentrated on broiler breeding, but prior to this the Hazlett company, a former franchise hatchery for SPB, commenced an independent breeding programme. The Amatil organisation now controls layer breeding operations previously conducted by Steggles, Hy-line and White Wings, so the continued independent operation of these programmes would be somewhat doubtful. National marketing of layer chickens from the Musgrove and Steggles breeding groups has now ceased although it is not entirely clear as to what future plans they might have.

REASONS FOR DEMISE OF TESTS

What reasons can be advanced to explain the declining interest in random sample laying tests in Australia? I would suggest the following:-

Changed structure of the poultry breeding industry

In the early 1970's there were perhaps 7 companies attempting to sell layer chickens nationally, where there now remains at best four, and more realistically two, independent breeders who overwhelmingly dominate the Australian market. The risks associated with a poor performance in published test results are more serious given the fairly large market share that each of the remaining breeders command.

Reluctance of state government authorities to continue subsidising tests

This was a major factor in the discontinuation of the SA test, and I suspect will be the same in Vic. Test managers have been pressured to make tests financially self sufficient, and with producer organisations and industry groups unwilling to contribute funds, entry fees charged to breeders increased substantially from the former nominal amounts. Fees reached levels that still did not cover the real costs of running tests, but were high enough to discourage franchise hatcheries and even primary breeders who were becoming increasingly responsible for directly entering the various state tests.

Dissatisfaction with the reliability of test results

This question has two aspects, firstly the ability to distinguish reliably between entries within tests, and secondly the applicability of test results to commercial farms. These points will be taken up later in more detail.

WHO USES THE TEST RESULTS?

The question as to whether the results of random sample tests are used in the manner for which they are intended needs to be addressed. Unfortunately there is very little data on the effect that test results have on subsequent sales, or on the use that is made of results by farmers.

Fox (1975) reported a survey of British farmers where 67% of respondants said they did use random sample test data to evaluate stocks, and 70% thought that tests should continue. A recent survey of egg producers in South Australia, however, found that 59% of respondants were not in favour of continued testing given that some industry based funding would be required for the continuation of the SA test. When asked to rank various sources used for making purchasing decisions random sample test results ranked last behind information obtained from respondants own farms, information from other farmers, and information from chicken salesmen. If these results are applicable to Australian farmers in general then serious doubt is cast on the relevance of layer tests to farmers, and on the justification of spending public monies for their support.

PRECISION OF RANDOM SAMPLE LAYER TESTS

The sample sizes per entry used in recent layer tests have varied from 96 birds per entry to 216 birds as shown below:-

Test	Number of Replicates	Birds per Replicate	Total Sample
30th NSW (1982/84)	8	18	144
24th SA (1983/84)	12	18	216
26th Vic (1983/84)	8	12	96
24th Tas* (1982/83	4	24	96

* Birds in cages only, also has 2 floor pens of 30 birds

Variation in egg number is the single most important determinant of laying hen gross margin - see for example Polkinghorne (1983), and so the following discussion will concentrate on this measurement, although the question as to whether hen housed egg number (HHP) is a better measure than hen day egg number (HDP) where corrections are made for birds that die during the test period will not be addressed here. Least significant difference (LSD) values are published in the final reports of tests in NSW, Tas and Vic and from these values the standard deviation of replicate means can be calculated if not directly published, and thus a coefficient of variation (CV) for individual egg number from a knowledge of the number of birds per replicate. Values averaged over the last four completed tests in these states are as follows:-

Test	HHP			HDP		
	Mean	LSD (5%)	CV	Mean	LSD (5%)	CV
NSW 27th-30th (1978-82)	230	16	29%	244	10	18%
Tas 21st-24th (1979-83)	221	13	21%	228	10	15%
Vic 23rd-26th (1979-84)	246	19	25%	260	14	17%

When data from all tests is combined and comparisons made between entries within years, (McDonald and Bruce, 1981; McDonald, 1984) LSD's in the range 10-32 eggs and 8-24 eggs for HHP and HDP respectively are obtained, depending on which pairs of entries are being compared. The last two Vic reports have reported LSD's for 3 Test Average values, but these turn out to be little different from the within test LSD's. Similarly the 3 year averages reported by McDonald and Bruce (1981) where data is combined over all test reports still results in LSD's of about 20 eggs for HHP and 13 eggs for HDP.

The fact that combining data over tests and years does not result in any marked improvement in the precision of comparisons supplies indirect evidence of real interactions between entries and tests and between entries and years. More direct evidence of such interactions was presented by McDonald (1981). If the interactions, particularly between entries and tests are real then the continued reduction in the number of tests severely limits the general applicability of results from those tests that remain. It also strongly argues against the concept of a national random sample test on a single site, especially from the point of view of those producers remote from the test site.

SUGGESTED SAMPLE SIZES

It is my opinion that the precision of entry comparisons demonstrated above is not acceptable given the present industry structures and could well be a major reason for the declining interest in random sample testing in Australia. Relatively insensitive tests may be acceptable when large numbers of breeders with widely different genetic merit enter such tests, but this is certainly no longer the case in Australia which now has only a very small number of breeding programmes and where differences between the remaining stocks are presumably quite small. To effectively discriminate between entries I would suggest a minimal precision expressed as an expected LSD of 5 eggs on a hen housed basis. Using the replicate structure utilized in the NSW test and past variation, this would require some 75 replicates, or testing about 1350 birds per entry. This is a rather unrealistic target given the size of existing test facilities and the very low prospects of finding funds to expand them. But what is the alternative - is there really any point in continuing with tests where the ranking of entrants is due more to chance than genetics?

Becker (1961) calculated the relationships between entry size and the probability of ranking first given a true superiority over 9 other entries. With the sample sizes that have been used in Australia, an entry that was 5 eggs better than 9 others that were each equally as good would have only a 25% chance of ranking first in terms of egg number in the Tas and Vic tests, about 32% in the NSW and still only 35% in the SA test! This is a very real problem as, despite statements in test reports concerning the need to consider observed differences in relation to the LSD's, I am sure that many readers either fail to understand, or choose to ignore these disclaimers and place undue emphasis on the rankings. Test managers do not exactly discourage this by presenting various awards for top ranking entries in some states. The problem of unreliable rankings is, unfortunately, quite intractable as in the example above the stock that is 5 eggs better than the

others still has only about a 45% chance of ranking first if the entry size is increased to 1000.

Fox (1975) argued that the probabilities derived by Becker (1961) may have used variances that were larger than those that apply to modern layer strains, and therefore under estimate the true values. Using data presented by Becker (1961) one can calculate an approximate coefficient of variation of 32% for hen housed egg number, which is certainly larger than the values derived above for Australian tests but not, I suggest, so much larger as to invalidate the general thrust of Becker's conclusions.

There is another aspect of sample size that was pointed out by Fox (1975) that needs to be considered in relation to the samples used being properly representative of the breeding programmes. Annual sales in Australia would be of the order of 10 million layer chickens so even if they were equally divided among say 5 breeders the question is raised as to how effectively a sample of 500 or even 1000 can be of the entire chicken sales when it represents less than 0.1%? The likelihood of major sampling effects due simply to chance are unfortunately large in such circumstances, even before attempting to account for different parent flocks, hatcheries and even generations which could have major effects on subsequent production.

A NATIONAL RANDOM SAMPLE TEST?

There is currently some thought being given to the formation of a national single site random sample test to replace the remaining state tests, with the reasoning that breeders and producers may be willing to support this concept rather than seeing the end to all testing. The logistics of this proposal are somewhat daunting, especially the necessary financing given the present squeeze on public monies for research and extension. I cannot see sufficient funding coming from industry sources for the necessary capital and operating expenses, and given the criticisms made above of the inadequate sample sizes of existing tests I could see little benefit in simply adding "national" to the title of the longest surviving of the existing tests. The major limitation of a single test is the possible existence of interactions. Evidence pointing to the presence of such effects has already been presented, although it is not possible to be adamant on this point if there are reservations about the adequacy of the samples used.

A good reason for retaining at least one layer test can be presented along the lines of allowing new breeders to enter the market. If a few breeders become dominant it becomes difficult for a new breeder to become established if no public tests are available for him to present his stock. Associated with this is the possibility of the entry of foreign breeders into Australia, if this were to occur then a soundly based random sample test would allow direct comparisons to be made with Australian stocks within at least one Australian environment.

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