tance. This counter may also be used for monitoring relatively flat surfaces such as laboratory tables for low-energy beta particles.

The plateau has less than a 4% rise per hundred volts from 1350 to 1550 volts. In this laboratory, the background of the counter shielded with 2 in. of lead is 28 cpm at 1375 volts. A 10-mg sample of barium carbonate containing 0.0005 μc of $C^{14}$ spread on a 10-cm² surface, gave a counting rate of 564 cpm (uncorrected) at 1375 volts. The sensitive area available on the sample holder is 20 cm². The counting gas is inexpensive and readily available. The counter is simple to construct or may be obtained commercially.[2] The time required for replacing a sample and flushing the counter is less than 3 min.

## Embryo Size and Productivity in Segregating Generations of Tomatoes[1]

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Much work has been done on size of embryos and their relationship to plant vigor in both inbred and $F_1$ hybrid populations; but the authors are not aware of similar experimental data in segregating generations except Faberge's (*4*) suggestion that early vigor in $F_2$ generations may be caused solely by initial seed weight advantage. Ashby (*1*) postulated that hybrid vigor in $F_1$ tomato lines was due to the possession by the hybrid of a larger embryo than that of the parental strains. Luckwill first confirmed this (*9*), but later (*10*) found evidence to indicate that no general relationship exists between embryo size and increased physiologic efficiency of $F_1$ hybrids. Other workers also have disagreed with Ashby's theory (*3, 5, 6, 8, 11, 13*).

Some experiments (*1, 2, 7, 8, 11, 13, 14*), however, have indicated that many $F_1$ lines showing hybrid vigor had larger seed or embryo size than the parental strains from which the hybrids were developed. Hatcher (*6*) has shown that size of seed in tomatoes is determined to a great extent by the number of seeds in a fruit. Natural self-pollination results in greater seed set per fruit than cross pollinating by hand; therefore, seeds from self-pollination are generally smaller in size. This does not explain the increase in size of a portion of the $F_2$ seeds (i.e., those produced by $F_1$ plants). Undoubtedly genetic control is also a factor in embryo size.

If it is assumed that in certain specified $F_1$ lines large size of seed is associated with hybrid vigor as measured in yields of fruit, and that such an association is carried into the segregating $F_2$ generation, a method is suggested whereby hybrid tomato seed may be produced by selection of seed harvested from $F_1$ fruits. It is possible to theorize further that if no relationship exists between seed size in tomatoes and productivity in an $F_1$ line showing considerable hybrid vigor, seed size and vigor may still be related in the segregating generation where transgressive segregation may occur. The first measurable evidence of vigor in segregating progenies might presumably be in larger embryo or seed size.

TABLE 1

AVERAGE WEIGHT PER SEED IN MG

| Generation | Diameter of seed 3000 + μ | 2500–3000 μ | 2000–2500 μ | Mean |
|---|---|---|---|---|
| $P_1$ Rutgers ..... | 3.43 | 2.89 | 2.38 | 2.90 |
| $P_2$ Pritchard .... | 3.43 | 3.15 | 2.56 | 3.05 |
| $F_1$ R × P ..... | 3.78 | 3.31 | 2.91 | 3.33 |
| $F_2$ R × P ..... | 3.69 | 3.01 | 2.29 | 3.00 |
| Mean ..... | 3.58 | 3.09 | 2.52 | ... |

Preliminary results have supported these possibilities. The correlation coefficients computed between seed weight and embryo weight and between average seed diameter and embryo weight were 0.978 and 0.867 respectively. Both exceed the 1% level of significance. Average seed diameter has, therefore, been used as a measure of seed weight, which in turn was used as a measure of embryo size. One-pound seed lots of two inbred strains of tomatoes, their immediate cross, and seed taken from $F_1$ generation fruits were sieved through soil screens with spherical openings averaging 3000, 2500, and 2000 μ. Table 1 indicates the average diameter and weight for each size class.

TABLE 2

EARLY AND TOTAL YIELDS IN TONS PER ACRE

| Generation and size of seed | 8/13/48 to 9/2/48 | | 8/13/48 to 9/30/48 | |
|---|---|---|---|---|
| Mean of Rutgers ..... | 2.4 | | 17.3 | |
| Mean of Pritchard ..... | 5.9 | | 18.1 | |
| $F_1$ from seed averaging 3.78 mg | 7.0 | | 20.6 | |
| $F_1$ from seed averaging 3.31 mg | 6.2 | $\overline{F_1} = 6.1$ | 20.1 | $\overline{F_1} = 19.6$ |
| $F_1$ from seed averaging 2.91 mg | 5.2 | | 18.1 | |
| $F_2$ from seed averaging 3.69 mg | 5.6 | | 19.4 | |
| $F_2$ from seed averaging 3.01 mg | 5.9 | $\overline{F_2} = 5.6$ | 18.5 | $\overline{F_2} = 18.7$ |
| $F_2$ from seed averaging 2.29 mg | 5.2 | | 18.1 | |
| Significant difference 19 : 1 .. | 0.89 | | 1.30 | |
| Significant difference 99 : 1 .. | 1.19 | | .... | |

The average deviation in seed weight within the inbred and $F_1$ materials was 26.5%; in the $F_2$ it was 38.0%. Assuming that the deviation in the $F_1$ and inbred lines was environmental (*12*), then 30% of the total variation in seed producing the $F_2$ progenies was due to hereditary factors.

The field trials included plants grown from each seed-size class for each generation ($P_1$, $P_2$, $F_1$, $F_2$). A split-plot design having six replications was used. Information was obtained on earliness, vigor of plants, size and shape of fruits, uniformity, and yield. Yields are of

[1] Authorized for publication on January 10, 1949 as Paper No. 1500 in the Journal Series of the Pennsylvania Agricultural Experiment Station.

[2] From the N. Wood Counter Laboratory, Box 76R1, Chesterton, Indiana.

primary importance and will be used to illustrate the preliminary results. Table 2 shows the mean yields obtained for Rutgers and Pritchard and the three seed-size classes producing the $F_1$ and $F_2$ generations of plants.

The preliminary results for this specific tomato hybrid appear to agree with the proposed hypothesis. It will be noted that the mean yield of the $F_2$ progenies, produced from the largest seed-size class, is comparable to the mean yield of progenies obtained from all seed sizes of the immediate cross. The smallest seed-size class producing the $F_1$ generation was, however, lower in production than its two larger seed classes, possibly due to accidental inclusion of a few self-pollinated seeds of the female parent, Rutgers. The fact that early yield in the smallest seed-size class was significantly less than in the other two classes also substantiates the supposition. Had the smallest class been comparable to the other two, the average total production in the $F_1$ generation progenies would have been 20.3 tons as compared to 19.4 for the largest seed class producing the $F_2$ generation progenies. More extensive field trials are planned for the coming season.

If a measurable association can be shown to exist between size of seed extracted from $F_1$ fruits and productivity in the $F_2$ generation progenies, a new method of producing hybrid seed in volume may result. Breeders of pure line tomato strains may also benefit by being able to select for vigor by seed size, thus eliminating the growing of considerable undesirable material.

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## Hypersensitivity in Cold-blooded Animals. II. Salamanders


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In a study of the effect of histamine on intestinal smooth muscle preparations of fish, Dreyer (*2*) observed that histamine produced contractions in teleost but not in elasmobranch smooth muscle. In a subsequent study Dreyer and King (*3*) were able to produce anaphylaxis in several teleost species, using as antigens horse serum and egg albumen injected intraperitoneally. Similar studies using elasmobranch species proved to be impractical because of technical difficulties. A search was then instituted for other cold-blooded animals which would show the same inability to react to histamine stimulation as elasmobranch species and be more suitable subjects in which to attempt protein sensitization.

Previous investigations using frogs as experimental animals have yielded results which are conflicting and difficult to interpret. Friedberger and Mita (*4*) shocked frogs sensitized to sheep serum and noted that the shocked animals displayed a weakness and curious loss of muscle tone. Isolated heart and other organ preparations failed to yield clear-cut results. Arloing and Langeron (*1*) failed to note any signs of hypersensitivity in their series of frogs treated with human serum. Kritchevsky and Birger (*7*) used frogs in which the blood was replaced by a colloid-free salt solution and noted that mammalian serum showed primary toxicity for these animals. Goodner (*6*) failed to produce satisfactory *in vivo* reactions using egg albumen and horse serum as antigens but did notice in the excised heart indications of developing hypersensitization. Friede and Ebert (*5*) demonstrated passive anaphylaxis in frogs and in some instances were able to produce symptoms of hypersensitivity in frogs actively sensitized. It is suggested that these widely divergent results, to which must be added our own negative results (*3*), were perhaps due to differences in the nutrition of the various experimental animals used. In some instances, frogs which had been held all winter without feeding failed to react, whereas frogs caught and used in the summer months showed irregular reactions that possibly might be considered significant.

Because of these variations the American newt (*Triturus viridescens*) was selected as a closely related species, which could be easily kept in the laboratory, and which could be fed without difficulty. *In vitro* and *in vivo* studies of possible hypersensitization were made in these animals. It was soon found that the tiny size of newt organs made them unsatisfactory for kymographic studies, and later studies were carried out using the mudpuppy (*Necturus maculosus*). During the investigation, the newts were kept at room temperature in a closed aquarium jar, in a few inches of water with access to rocks. They were fed three times a week and would accept only live food, taking flies and earthworms readily. With the coming of cold weather they ceased to feed, and the series, which was almost completed, was discarded. The mudpuppies were kept in running water at 18° C and refused to feed when offered earthworms, sliced rabbit liver, or rat meal. They were well fed on arrival and were all used within a month; most of the earlier animals sacrificed for tissue had food in the gut.

Injections were made intraperitoneally at a point midway between the front and hind legs. Horse serum was the only antigen used. This was about 10 months old but had been stored at −20° C without preservative. Sensitizing and shocking doses, which ranged from 0.05 to 0.10 ml for the newts and 0.20 to 0.30 ml for the mud-