

INCREASING CASTOR BEAN ALLERGY IN SOUTHERN CALIFORNIA DUE TO FERTILIZER

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IN 1923 Bernton¹ reported a case of asthma due to castor bean sensitivity in a laboratory worker. This man had been working with the beans on a research project. Since that time approximately fifty cases of allergy to the inhalation of castor bean dust have been reported in the literature. The work of Figley and Elrod² demonstrated that 30 out of 32 asthmatic persons who lived in close proximity to a castor oil factory were highly sensitive to an extract of the dust. This work was, I believe, significant in that it demonstrated an unusually high incidence of respiratory allergy in an area which was heavily contaminated with the fine dust particles of the castor bean. It suggests that sensitivity may be rather easily acquired through close association with this highly potent allergen. Vaughan³ reported three cases of castor bean allergy in persons who were exposed to the castor bean pomace used in fertilizer. Robbins,⁴ Arnold,⁵ Snell,⁶ Follweiler and Haley,⁷ Barnard,⁸ and Bennett and Schwartz⁹ have all contributed to the literature of clinical allergy to castor bean dust. Ratner¹⁰ who had previously succeeded in sensitizing guinea pigs by the inhalation route to other allergens stated that castor bean dust was a potent sensitizer by this same method.

During the last six years I have seen 17 patients who showed markedly positive skin reactions to a 1:10 crude extract of the castor bean by the puncture method. The puncture test consists of pricking the skin once with the sharply ground double point of the partially cut-off eye of an ordinary sewing needle, which has just been dipped into the solution of antigen. In 14 of these patients it has been possible to elicit a history of clinical sensitivity to the dust of the bean, and 11 have had either clinical hay fever or asthma from inhaling the pomace now being used commercially as fertilizer.

Serum was drawn from only 5 of the 14 clinically sensitive patients. Circulating reagin was demonstrated in all by passive transfer. The technique consisted of the intracutaneous injection of 0.1 c.c. of serum from each into a separate site on the forearm of the recipient. Forty-eight hours later each of the 5 sites was challenged by puncture testing each site with a 1:10 crude extract of the castor bean. Two control puncture tests were made with the same extract.

Ten of the 17 patients were tested both by the puncture and intradermal methods with extracts of the pollen of *Ricinus communis* (castor bean). These reactions were all negative.

Correlation between positive skin reactions and clinical sensitivity is at times difficult to clarify. Although scientific proof may be obtained by having the patient inhale the allergen in question under controlled conditions, I was not enthusiastic over this approach when dealing with a substance as potent as castor bean. I am, therefore, presenting brief case histories of this group of patients in support of my position.

CASE HISTORIES

CASE 1.—E. B., a 57-year-old white, male, American, married, retired auditor. He was first seen in October of 1951 because of an asthma of 6 weeks duration.

In September of 1951 he spread approximately seven pounds of castor bean pomace on a small patch of dichondra (a grass substitute for lawns). While doing this job his nose and eyes began to itch and water, and he sneezed excessively. Very shortly thereafter his chest became tight and he retired to the house to sit down. His wife found him about a half hour later in great respiratory distress, sweating profusely, and cyanotic. The doctor whom she called immediately administered epinephrine, which gave only temporary relief. He was hospitalized for two days, but was still wheezing slightly when dismissed. During the next 6 weeks he continued to have asthmatic attacks in spite of home treatment with epinephrine, tedral, aminophylline, and finally a course of cortisone.

TABLE I. SUMMARY OF CASES

PATIENT	AGE	SEX	RACE	SKIN TEST RE- ACTIONS	PASSIVE TRANSFER REACTIONS	CLINICAL FROM CASTOR BEAN	SOURCE OF MATERIAL
1. E. B.	57	M	W	++++	+++	Asthma	Fertilizer
2. J. D.	25	F	N	++++		Asthma	Fertilizer
3. V. L.	31	F	W	+++	+++	Cough	Fertilizer
4. A. B.	30	F	W	++++		Asthma	Ricinus communis Plants in neighborhood
5. M. R.	16	M	W	+++		Asthma	Fertilizer
6. M. H.	29	F	W	++++	+++	Asthma	Fertilizer
7. W. J.	24	F	W	++++		Asthma	Fertilizer
8. P. E.	6	M	W	++		Hay Fever	Fertilizer
9. J. T.	57	F	W	++++		Asthma	Fertilizer
10. C. A.	28	F	W	+++	++++	Asthma	Fertilizer
11. M. A.	57	F	Mon- golian	+++	+++	Asthma	Fertilizer
12. R. S.	30	M	W	+++		Asthma	Fertilizer
13. C. G.	27	F	W	+++		Hay Fever	Ricinus communis Plants in neighborhood
14. E. L.	35	F	W	++++		Asthma	Castor bean dust
15. R. O.	7	F	W	++		Has Asthma; cannot correlate with castor bean sensitivity	
16. A. S.	29	F	W	++++		Eczema and Asthma; cannot correlate with castor bean sensitivity	
17. E. E.	14	F	W	++		Asthma. Never correlated with castor bean.	

I saw him in October of 1951 after approximately 6 weeks of chronic asthma. On physical examination the following essential points were noted: Blood pressure, 190/110; Dry tongue; moderate emphysema; dry fine expiratory wheezing râles throughout chest; no ankle edema; chest x-ray and ECG, normal.

Three days of hospitalization with intravenous fluids, iodides and aminophylline resulted in complete relief. The blood pressure dropped to 140/85. During his stay in the hospital all traces of the castor bean dust were removed from the home. The area of dichondra which had been fertilized was kept soaked for days. Since his return home he has been entirely well.

He was tested by the puncture method in my office to about 150 allergens and showed but one reaction—4 plus to castor bean.

It is of interest to note that in July of 1951, three months before the onset of his asthma, he fertilized his entire front lawn with about 100 pounds of castor bean pomace. During this process the only reaction was a runny nose. It is also of interest that he has never had asthma previous to the present episode.

CASE 2.—J. D., a 25-year-old, American, married, Negro housewife. She was first seen in 1950 because of asthma.

This woman was approximately 7 months pregnant and was doing well until her husband fertilized the front lawn with castor bean pomace. Within a half hour after he came into the house she was having a violent attack of asthma. An injection of $\frac{1}{4}$ c.c. of 1:1000 epinephrine controlled the attack. She was seen a few days later and tested to approximately 80 allergens. Castor bean showed a 4 plus reaction by puncture. All others were negative. This was her first and only attack of asthma in 15 years.

CASE 3.—V. L., a 31-year-old white, American housewife. She was first seen in 1950 because of a chronic cough.

This patient was a very interesting problem in that she was sent to me by a chest surgeon, to whom she had been referred with a diagnosis of possible bronchiectasis. The chest surgeon's history and physical examination suggested that the cough was of allergic origin. Complete skin tests, both puncture and intradermal, were done, and the only positive obtained was a 3 plus reaction by puncture to castor bean dust. Investigation disclosed that adjoining neighbors had been using the castor bean pomace on their lawns. Attention to the details of eliminating the dust has resulted in a complete cessation of the cough.

CASE 4.—A. B., a 30-year-old, white, American housewife. She was first seen in 1949 because of asthma.

Routine skin testing provided the key in detecting the cause of this woman's asthma. She had had some asthma in childhood, but had been entirely free for many years. Within a week after moving into a new home, approximately 6 months before I saw her, she had gone into status asthmaticus, which had required hospitalization. Upon her return home following this hospitalization she became chronically ill with asthma. History taking did not seem to give any clues, but when the skin tests were done there was a 4 plus reaction to the castor bean extract by the puncture method. Investigation of the home disclosed a large patch of *Ricinus communis* (castor bean) growing at the back of the lot, in close proximity to the clothesline. These plants were practically trees, some of them over 20 feet in height, and had obviously been there for many years. Removal of this group of plants and soaking down the back yard was only partially effective in the control of her disease. Eventually the entire inside of the house was scrubbed, the back yard was plowed up, soaked with water every day for 2 weeks, and the neighbors on each side of the house eliminated their castor bean plants. She gradually improved, and has had no severe asthmatic attacks since. This house was in a new tract and we were never able to determine whether castor bean fertilizer had been used on the new lawns.

CASE 5.—M. R., a 16-year-old white, American schoolboy. He was first seen in 1950 because of asthma.

This boy had been quite well until about a month before I saw him, at which time while playing with a friend on a neighbor's lawn he suddenly developed violent sneezing and itching of his nose. Asthma followed within a half hour. Adrenalin was administered at the Emergency Hospital. Following this episode he continued to have occasional mild spells of asthma, and came in for investigation. The skin tests disclosed a 3 plus puncture reaction to the castor bean extract, and investigation by the parents turned up the fact that the lawn on which he had been playing, when he had the first attack, had been fertilized with castor bean pomace approximately a week earlier. No further treatment seemed necessary and he has been well.

CASE 6.—M. H., a 29-year-old, white, American housewife. She was first seen in 1951 because of asthma.

She had not had any asthma for many years until on May 30, 1951, the lawn was fertilized with castor bean pomace. Within an hour or so after this process was started she had nasal symptoms and severe asthma. She went to the beach that night and the asthma cleared. On returning to the home the asthma recurred. She was referred to my office, and on complete skin testing there was a 4 plus reaction to castor bean by the puncture method, and no other significant reaction. She was advised to return to the beach temporarily.

A thorough house cleaning, during her absence, and constant soaking of the lawn have enabled her to live at home. She does, however, still have a little mild asthma, which is readily controlled by medication.

CASE 7.—W. J., a 24-year-old, white, American housewife. She was first seen in 1946 because of asthma.

Her mother died when the patient was 7, father remarried when she was 10, and about that time she began having asthma. After a period of adjustment the asthma disappeared completely. At the age of 23 the asthma recurred. She had been married 5 years and was the mother of 3 children. After about three violent attacks she was referred to me, and it was found on questioning that the most recent of these attacks had occurred following the spreading of castor bean pomace on their rather extensive lawns. Thorough soaking of the lawns over a period of many days, complete house cleaning, including walls and furniture, resulted in cessation of the asthma. Some weeks later her two small sons came into the house from play and were in close contact with her. Within minutes her nose began to itch, her eyes watered, and she began to wheeze. Superficial analysis might suggest a psychological problem here, but questioning disclosed that the two boys had been in the green house throwing handfuls of the castor bean fertilizer at each other, and their clothing was, of course, well saturated with the material. Careful attention to the removal of all castor bean fertilizer from the premises resulted in a complete cessation of the asthma. Complete skin testing by puncture and intradermal techniques disclosed a 4 plus puncture reaction to castor bean and questionable reactions to house dust and pyrethrum. These latter two were considered to be unimportant.

CASE 8.—P. E., a 6-year-old, white, American schoolboy. He was first seen in 1949 because of hay fever.

The patient eliminated contact with castor bean fertilizer by avoiding a certain neighbor's lawn, and the hay fever improved sufficiently so that no further treatment was needed. Puncture reaction to castor bean dust was 2 plus, questionable reaction to molds. No other sensitivities.

CASE 9.—J. T., a 57-year-old, white female, American teacher. She was first seen in 1951 because of hay fever and mild wheezing.

Approximately 6 weeks before I first saw her, she had a violent attack of hay fever with mild wheezing, following a fairly heavy exposure to castor bean pomace, used in fertilizing her garden. It is of interest that when she used to visit her parents in the Santa Ana area approximately 20 years ago she always had hay fever, and has noted since that wild castor beans grow in profusion around the place. For a number of years she has taught a course twice weekly at a plant nursery, and always has had some hay fever and cough at those times. Complete skin testing disclosed a 4 plus reaction to castor bean dust and 1 plus reaction to house dust. She is under treatment for the house dust and is much improved. She has been careful to avoid castor bean contact.

CASE 10.—C. A., a 28-year-old, white, American housewife. She was first seen in 1946 because of asthma.

When this young woman first came to me she was having chronic asthma. Complete skin tests at the time were negative, except for a 3 plus puncture reaction to castor bean. It seemed unlikely that this was the cause of the asthma. Investigation disclosed sinusitis and after this condition was cleared the asthma gradually became less of a problem. Because of the severity of the disease we attempted specific treatment with a castor bean extract. After four months this was discontinued, since it seemed to be ineffective. It is of interest to note that as a 10-year-old child she and some of her friends made "castor bean soup." Fortunately they ate very little of it, but even so she was violently ill with severe abdominal cramps for days. I was not able to obtain a clinical history of asthma as a result of exposure to castor bean dust until very recently. While driving by a church on her way home from my office she noted that the lawn of the church was being fertilized and the dust from this was blowing across the street. Within 5 minutes she was having hay fever, and by the time

she arrived home detected a definite wheeze in her chest. She telephoned the church and the gardener confirmed her suspicions that the fertilizer he was using was castor bean pomace. This attack was very mild and passed off rapidly.

CASE 11.—M. A., a 57-year-old widow, Japanese born, agricultural worker. She was first seen in 1951 because of asthma.

In the spring of 1951 this woman began having hay fever while working in a 3 acre strawberry patch. The strawberry beds were treated with castor bean pomace one afternoon while she was working there, and the hay fever became very severe. After her return home that evening her chest tightened up and during the night she had her first severe attack of asthma. I saw her early the following morning and there were the usual typical expiratory râles of a subsiding attack. Due to the fact that this woman spoke no English it was only later, after skin testing was done, that we learned the composition of the fertilizer which had been used on the strawberry patch. She had a 3 plus reaction by the puncture method to castor bean, and this was her sole skin sensitivity on complete testing. Her tolerance appears to be reasonably high, because she continues to work in the strawberry fields and avoids them now only during periods of fertilization. She recently had a mild attack of asthma after doing some work in her son's garage. He is a gardener and transports castor bean fertilizer in his truck. The family have now been alerted to the necessity of keeping her away from this allergen. It is of interest to note that during the war she was in a Japanese detention camp in Arizona, where there was a great deal of *Ricinus communis* growing.

CASE 12.—E. S., a 30-year-old, American, dairy delivery man. He was first seen in 1948 because of nasal allergy and occasional asthma.

This man came to my office because of nasal blockage, headaches, and nasal discharge. He was referred by a psychiatrist who had been treating a nervous condition which he developed in the South Pacific during the war. His sensitivities were mild to the chenapod group of pollens, house dust, and shell fish. Castor bean was markedly positive by puncture test. There was no known clinical sensitivity to castor bean at the time the history and initial skin tests were done. Approximately 2 years later he spread castor bean pomace on his lawn and developed one of his very rare episodes of asthma, moderately severe, and lasting for about 24 hours. He has avoided this antigen carefully for the past 2 years and has had no further asthma.

CASE 13.—C. G., a 27-year-old, white, American housewife, 4 months pregnant. She was first seen in 1951 because of sneezing, coughing, and asthma.

Within a month after moving to the Pasadena area in March of 1951 she began to have attacks of sneezing. About 3 months later she began to cough and wheeze. She came from the Boston area where she had never had anything even resembling hay fever, although she had worked for a number of years in summer camps in the country. A local California physician had treated her cough with diathermy, and had done extensive skin tests. He reported plus reactions to a large number of foods and inhalents, including milk, but none of these reactions appeared to have been diagnostic. A very limited number of skin tests were done in my office and the only positive reaction was a 3 plus by puncture to castor bean. A visit to the home disclosed that *Ricinus communis* was growing in profusion at the back end of her yard. A 5 day course of penicillin, fluids, and iodides cleared up the cough and asthma. Cooperation between her husband and the tract owner has eliminated the castor bean plants. Our winter rains have soaked the ground thoroughly and she is clear of symptoms.

CASE 14.—E. L., a 35-year-old, white, American housewife. She was first seen in 1944 because of asthma.

At the age of 11 the patient chewed up one castor bean and had recurrent abdominal cramps for many months. At the age of 19 she handled a few castor beans and developed marked edema of the eyelids. Some years later she swept out a shack where a bag of castor beans had been stored and suffered her first violent attack of asthma. Puncture reaction to

castor bean, 4 plus; 2 plus to shrimp, crab, lobster (which caused clinical angioneurotic edema). She also had positive intradermal reactions to sagebrush and ragweed, with a history of clinical hay fever from sagebrush.

CASE 15.—R. O., a 7-year-old, white, American schoolgirl. She was first seen in 1950 because of asthma.

This child had many skin reactions, both to puncture and intradermal tests, among them being a 2 plus puncture to castor bean. Although no correlation between this skin test and clinical castor bean allergy is known, the family was warned of the possibility.

CASE 16.—A. S., a 29-year-old, white, American housewife. She was first seen in 1949 because of asthma and eczema.

This patient is included only because of her 4 plus puncture reaction to castor bean dust. She also had large puncture reactions to house dust, cat, Bermuda grass, and olive pollens. Treatment with the inhalants other than castor bean has resulted in alleviation of symptoms. She has been warned about castor bean sensitivity and has so far avoided contact with it. At least we have no knowledge of asthma from contact with the castor bean dust.

CASE 17.—E. E., a 14-year-old, white, American schoolgirl. She was first seen in 1948 because of asthma.

This is not specifically a castor bean case, although she did have a 2 plus puncture reaction to the antigen. She was specifically sensitive to peanuts and other nuts by skin tests and clinical experience. There has been no clinical history of asthma from castor bean dust.

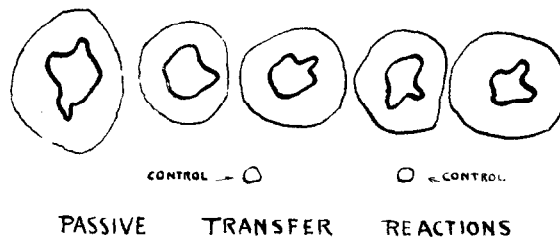


Fig. 1.—Serum which sensitized these sites was taken from 5 castor bean-sensitive patients. Challenged with 1:10 crude extract of castor bean puncture method.

The history of the castor oil industry in Los Angeles dates back to 1933, at which time the California Flaxseed Products Co. began pressing the oil from a few thousands pounds of castor beans. They have continued this part of their business ever since, with an annual production of anywhere from 100 to 900 tons of oil. Since the ricin remains in the cake after pressing, this residue, "pomace," although high in nitrogen (6 per cent), phosphorus (2 per cent), and potash (1 per cent), has no value except as a fertilizer.

In 1946 the Baker Castor Oil Co. built a plant in Los Angeles, and in 1951 produced in the neighborhood of 7500 tons of castor oil. Since the castor bean is approximately 50 per cent oil, it follows that the Los Angeles plant is producing 7500 tons of castor bean pomace. This is at least a tenfold increase in the last 5 years.

Investigation of local dealers in fertilizer disclosed that castor bean pomace sells for less than half the price of cotton seed meal, and has approximately the same qualities. It is, therefore, not surprising that it is being extensively used for lawns, shrubs, and flower beds in the Los Angeles district.

Nationally, the picture is also one of increasing production. During the decade of 1940 to 1950 the annual consumption of castor oil by United States

industry has been approximately 75,000 tons. United States consumption from 1930-1940 was not over 30,000 tons annually.

The chemistry of the castor oil molecule is the reason back of the increasing demand. There is at present no satisfactory substitute for industrial use, and the Baker Company alone has developed over 150 different uses for the oil or fractions of it. Industrially, it is important in paints, varnishes, lacquers, plastics, rayon, nylon, asphalt tile, rubber, textiles, cosmetics, ink, electrical insulations, fungicides, rubber products, soap products, and artificial leather. It is used also very extensively in jet engines, hydraulic and brake fluids, recoil mechanisms, military all purpose grease and explosives.

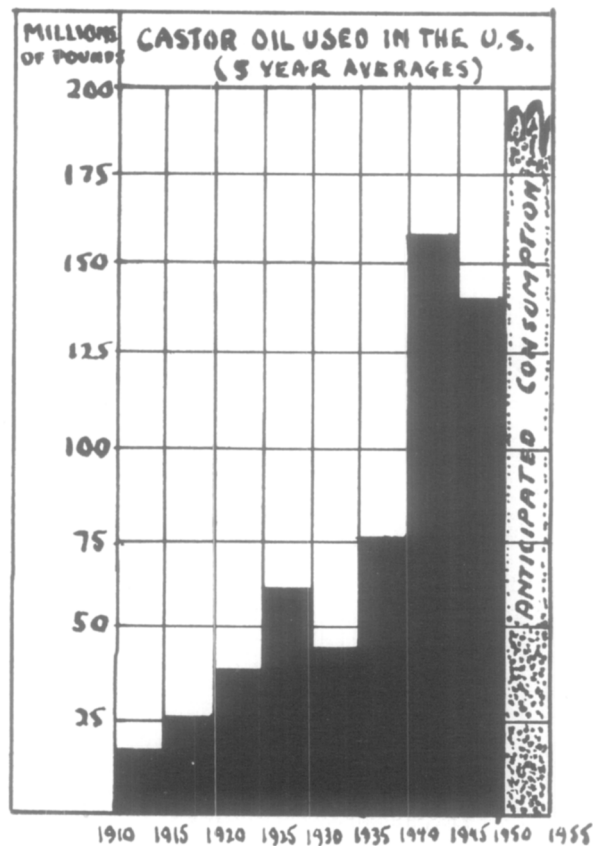


Fig. 2.

Since the demand for oil is so great and since our entire source of the beans was of foreign origin, the United States Federal Government has been promoting the domestic raising of the beans. They have worked closely with the Baker Castor Oil Co. in the development of proper seed, and the United States Department of Agriculture has guaranteed a minimum price of 10 cents per pound to the farmer on home grown beans. Harvesting and hulling machinery has been developed. In 1949 less than 100 acres were cultivated. In 1950 this figure

jumped to 9000 acres, and in 1951 to 84,000 acres. California and Arizona raised 30,000 acres of beans in 1951, and Texas and Oklahoma most of the balance. The national goal for 1952 is 200,000 acres. If this is achieved we may expect a domestic production of 100,000,000 pounds, or approximately one-fourth of our present need.

Those who deal with castor bean products other than castor oil or derivations of the oil should be aware of two potential hazards: (1) the toxic albumin ricin and (2) the castor bean allergen. The toxic component ricin is universally poisonous to man and other mammals. The castor bean allergen possesses no inherent toxicity in the absence of specific sensitivity. Since the Baker Company

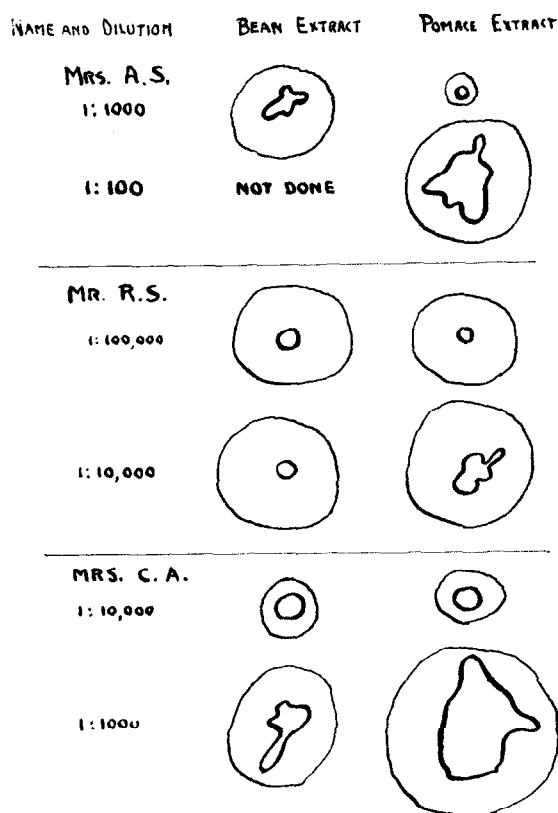


Fig. 3.—Comparison between extracts of castor bean and castor bean pomace (Baker C. O. Co.)
Direct skin tests—puncture method.

showed me some evidence that its pomace contained less ricin than pomace manufactured by another which does not use the final solvent-extracting procedure, it occurred to me that the antigenicity of its product might be correspondingly lower. I felt, therefore, that this paper would be incomplete unless the antigenicity of Baker pomace was compared directly with an extract of the bean. Tenfold dilutions of the two antigens were made and tested by puncture on the backs of three of the patients. It will be seen from the charts

that the bean antigen is not more than 10 times as potent as the pomace. In one instance they appear to be about the same. This pomace has been subjected to solvents at high temperature and finally to live steam.

DISCUSSION

The California Flaxseed Company has found an incidence of 21½ per cent clinical sensitivity to castor bean among its small group of employees. In El Centro at the loading platform where flaxseed, grains, and castor beans are stored and loaded into box cars for shipment, two of their group of ten employees have clinical allergic manifestations when the castor beans are being handled. I was unable to find any record of trouble among the farmers who were raising the beans, although sensitivity among farmers who use the pomace for fertilizer is well known in this district.¹¹

It is to be remembered that this crop is very new, and another year or two may well be required to show what the incidence of sensitivity is going to be among the persons closely associated with the industry.

The author of an excellent book on allergy¹² devotes only one paragraph to castor beans, and I quote:

“Miscellaneous Inhalants: Included in this group are inhalant substances which can provoke allergic symptoms but seldom are encountered in ordinary practice. This is true, for example, of castor bean, which has been responsible for respiratory symptoms in pharmacists or laboratory workers who handle these beans. The dust of these beans also has caused asthma in patients living in the vicinity of castor bean mills, and in farm workers or others who work with fertilizer which contains castor bean flour.”

The great increase in the national production of castor oil is, I believe, going to take this allergen out of the “seldom encountered” group because of the corresponding increase in fertilizer production and use. I recently received literature from a relatively new company in Oklahoma City, which is producing antigens for doctors. Its brochure listed over 400 different allergens, but castor bean was not in the list, in spite of its proximity to new centers of castor bean production.

Although castor beans have been processed in New Jersey for a hundred years, those of us who live in California, Arizona, Texas, and Oklahoma should be aware that a new industry has been born. Its by-product fertilizer is likely to find its way to faraway places, and due to the potency of this allergen I would suggest that allergists throughout the nation be “en garde.”

CONCLUSIONS

1. During the past 5 years I have seen 9 patients with asthma and 2 with hay fever as a result of inhaling castor bean pomace. During the previous 5 years I saw only one.

2. There has been at least a tenfold increase in the production of castor bean pomace in the Los Angeles district from 1946 to 1951. This will probably be increased another 4 times in the next year.

3. Because of the increase in production and the extreme toxicity of the castor bean allergen it is suggested that proper labeling of fertilizers be mandatory.

4. Since it is unsafe to do intradermal tests with castor bean allergen unless the ricin has been removed, it is suggested that all allergists who have not routinely tested to castor bean do puncture tests on their patients with a concentrated extract of the bean. The puncture method appears to be entirely safe, whereas even a scratch test, if the scratch is long and deep, may cause a constitutional reaction.

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