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# TEXAS AGRICULTURAL EXPERIMENT STATION

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DIVISION OF VETERINARY SCIENCE  
IN COOPERATION WITH THE BUREAU OF ANIMAL INDUSTRY,  
UNITED STATES DEPARTMENT OF AGRICULTURE

PSILOSTROPHE TAGETINAE AND PSILOSTROPHE GNAPHALODES,  
TWO PLANTS POISONOUS TO SHEEP AND CATTLE  
ON THE RANGES OF THE SOUTHWEST

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Two plants, *Psilostrophe tagetinae* and *P. gnaphalodes* have been found to be poisonous to sheep. These two plants occur over a large area of west Texas. Their botanical description and exact distribution as far as known is given.

Poisoning resulting from eating these plants manifests itself in general malaise, weakness in the legs as evidenced by stumbling when running, regurgitation of food as indicated by a greenish staining of the lips, and finally death. No remedy is known. Losses can be prevented by changing the animals to pastures not infested by these plants.

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PSILOSTROPHE TAGETINAE AND PSILOSTROPHE GNAPHALODES,  
TWO PLANTS POISONOUS TO SHEEP AND CATTLE  
ON THE RANGES OF THE SOUTHWEST

FRANK P. MATHEWS\*

IN COOPERATION WITH THE BUREAU OF ANIMAL INDUSTRY,  
UNITED STATES DEPARTMENT OF AGRICULTURE

In September, 1931, H. Schmidt, W. T. Hardy, and V. L. Cory<sup>1</sup> of the Station staff went to the Bullis Gap country in Brewster county to investigate some losses among sheep occurring on two adjoining ranches. At the time of the visit losses had practically ceased because most of the sheep had been moved to different country. However, one sick sheep was available for autopsy on each ranch. Both animals showed symptoms of a general malaise and in addition one of them, a yearling ewe, showed a greenish stain of the lips, which the owner reported as having been caused by the sheep vomiting ingesta while being brought from the pasture an hour earlier. Such vomiting accompanied by general weakness was reported as a common observation in the affected sheep. The autopsy of the two animals revealed no definite lesions. For this reason material from kidney and liver was fixed in formalin for sectioning and microscopic study. This study was conducted by Schmidt, who observed extensive albuminous degeneration in the kidney tubules of both animals. A small number of the tubules showed casts. No changes were found in the liver cells.

While making the autopsy of one of the sheep the owner stated that he knew what was killing his sheep and pointed out a yellow blooming weed which he said the sheep had been eating. This opinion was supported by the fact that losses had not occurred until after this weed made its appearance. As soon as he moved his sheep from the range where this weed occurred his losses ceased. The plant was identified by Cory as *Psilostrophe gnaphalodes* DC. A large bagful of this plant was collected to be fed to a sheep. Through a misunderstanding this was not done until five months later when 10,190 grams dry weed was fed to a sheep in 26 days with no bad effects.

A general survey of the vegetation, on the two ranches involved, showed that it consisted in the main of a number of different kinds of shrubs, mostly creosote bush and other shrubby plants, much lechuguilla, and here and there a sprig of chino grass (*Bouteloua breviseta*). A grass turf was entirely lacking and the above mentioned weed constituted the only green herbaceous plant present. Both ranchers stated that they had not had any trouble resembling lechuguilla poisoning in their sheep.

In the latter part of November 1932, this plant was again encountered on a ranch in central Pecos county by Hardy and Cory and again a collec-

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<sup>1</sup>Forty-sixth Annual Report, 1933. Texas Agricultural Experiment Station.

tion of green plant was made. A feeding test with a lamb was started with this fresh, green material on December 1. Force-feeding was practiced which produced esophagitis, necessitating two interruptions in the feeding. This lamb consumed 3,115 grams of the weed in 23 out of 38 days with negative results. In the meantime another feeding trial was started by Boughton and Hardy on December 19th with another lamb, again using fresh, green plant. This lamb consumed 2,330 grams of the material in 20 out of 30 days, again with negative results.

On December 29, 1932, the writer and Cory were directed to proceed to a ranch near Kent, Texas, in southeastern Culberson county to investigate some sheep losses. Cory being familiar with the work on *Psilostrophe* at the Sonora Station, called attention to the presence of *P. tagetinae* on the ranch, and since abundant material was available a thorough feeding test was undertaken. During the remainder of the winter and the following spring, similar conditions were encountered in several localities. From our investigations it was evident that this problem was common to a large portion of the sheep ranges of the Trans-Pecos area and in all probability common to a considerable portion of the southwest.

The outbreak in December 1932, involved 9,000 head of sheep which were maintained on a seventy-five section ranch. This ranch was divided into several pastures but the losses were confined to two pastures, which extended along the north end of the ranch. During the summer of 1932, a total of 1,162 head of sheep were placed in these two pastures. This bunch appeared thrifty until the first of November when a few sick animals were found. The illness spread through the flock at an alarming rate and they were removed to another pasture. With the exception of eight head all made a rapid and complete recovery. On November 24, 1932, a second lot, consisting of 1,800 head of sheep were divided into two bunches and placed into the same pastures. All the sheep appeared to be doing well for about three or four weeks when several sick animals were found in each pasture. During the week preceding the visit to this ranch the illness again made a rapid spread through this part of the flock and by December 29th at least 50 per cent. of the 1,800 head were showing evidence of sickness. During this time 23 head were known to have died, perhaps several more.

In this and similar outbreaks which have since been investigated in the Trans-Pecos area the mortalities have varied from 3 to 20 per cent. depending on the ability or willingness of the owners to establish preventive measures. As a rule the mortality occurred in certain pastures with little or no evidence of poisoning in adjacent pastures. In fact, it was unusual to find losses of this sort occurring on an entire ranch. The geographical distribution was, therefore, of some assistance in establishing the etiology and later of value in controlling the disease. The investigation of the etiology of this condition was directed towards poisonous plants since an abundant growth of either *P. tagetinae* or *P. gnaphalodes* was found in pastures where losses had occurred with little or no growth in adjacent pastures.

BOTANICAL DESCRIPTION OF *Psilostrophe tagetinae*\*

*Psilostrophe tagetinae* (Nutt.) Greene is a low corymbosely branched (with several to many stems from the base and of equal length) woolly, perennial herb from a tap root. The stems are strict, leafy, loosely woolly or villously woolly, prominently 8- to 10-ribbed, and branched at the top. The leaves are alternate, loosely woolly on both surfaces, and decrease in size from the base upwards, the foliage usually forming a basal rosette growth in the winter months. The basal leaves are longer and broader than the stem leaves, being broadly spatulate and frequently are pinnately cut into lobes. The stem leaves are narrower and usually are entire, usually less than 5 cm. long and 6 mm. broad or less, spatulate below the flowering branches and there usually linear. The heads are small and numerous, mostly cymosely clustered and short-stalked. The involucre is cylindrical and densely woolly, 7 mm. long and 3 mm. broad, of about 8 narrow, equal, erect, leathery bracts, but sometimes with 1 to 4 small papery bracts within. The receptacle is small, flat and without hairs or scales. The ray-flowers are yellow, 3 to 4 to each head, with the ligule as broad as, or broader than long, about 4 mm. broad, the apex with 3 broad and rounded lobes, and abruptly contracted at the base into a narrow tube, nearly 3 mm. long, which is bearded with woolly hairs. The ligule persists on the achene and becomes pale or whitish or thin-papery with age. The disk-flowers are 6 to 8 in number, or about twice as many as the ray-flowers, and their corollas exceed the involucre up to as much as 2 mm. and have glandular-bearded teeth, but the corolla-tube itself is free from hair. The achenes are free from hair, narrow, cylindrical, obscurely ribbed or angled, 2.5 mm. long, more or less, and 0.75 mm. broad. The pappus is of 6 or less oblong-lanceolate or subulate-lanceolate papery scales, which are about as long as the achene or almost three-fourths as long as the disk-corollas, and are entire or essentially so.

BOTANICAL DESCRIPTION OF *Psilostrophe gnaphalodes*

*Psilostrophe gnaphalodes* DC. closely resembles the preceding species in foliage, manner of growth, and general appearance, but usually it is markedly woollier. Its involucre is shorter (5 mm. compared with 7 mm.) and is nearer campanulate, or bell-shaped, than it is cylindric. The flowers are similar in number, but in this species the ligules of the ray flowers are much broader than long, being 8 or 9 mm. broad and less than 5 mm. long, excluding the corolla-tube which is 2 mm. long. The characteristic difference between the two species lies in the fact that the somewhat longer achenes of *gnaphalodes*, instead of being free from hair as in

\*Description and geographical distribution of plants by V. L. Cory, Botanist, Texas Agricultural Experiment Station, Substation No. 14, Sonora, Texas.

tagetinae, are densely clothed with long, woolly hairs, which are even longer than the achenes. Also there is a characteristic difference in the pappus of the two species, for in tagetinae the scales are entire or essentially so, while in gnaphalodes the margin and especially the apex of the pappus scales are delinquescent into long, woolly hairs, those from the apex even longer than the body of the scale.

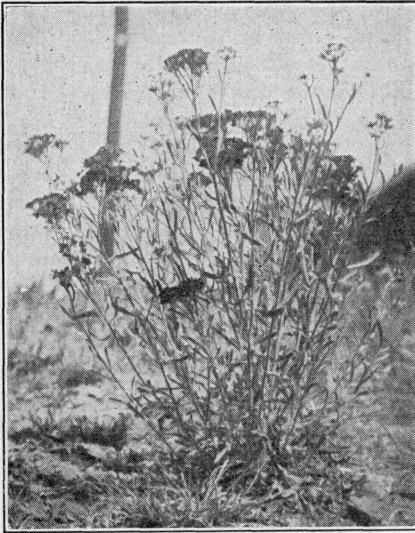


Fig. 1. *Psilostrophe gnaphalodes*.

The two species of *Psilostrophe* are alike in general appearance and may be recognized readily from all other plants in the localities where they grow by the following distinctive characteristics. The plants are herbs about one foot in height, grayish-green in color due to a covering of conspicuously woolly hairs on their surface. They are widely branched at the base, the branches are erect or ascending and bear their small heads of yellow flowers in flat clusters at an equal height from the ground. Each head contains only three or four ray flowers. These are small, yellow in color and remain and persist after maturity, becoming papery in age.

#### GEOGRAPHICAL DISTRIBUTION OF THE PLANTS

Both these species of *Psilostrophe* occur locally in the Trans-Pecos area in abundance; but *gnaphalodes* appears to be confined to Texas, whereas *tagetinae* occurs from Colorado on south through western Texas and on west to Arizona. Probably one or both occur in northern Mexico. For the most part the distribution of *tagetinae* is to the north and west of *gnaphalodes*, but there is an overlapping of the two species in Brewster county, and possibly elsewhere. *Gnaphalodes* is abundant in localities in Pecos, Terrell, and Brewster counties, while *tagetinae* is equally abundant in counties north and west thereof. In 1933 both species were collected east of the Pecos river. *Tagetinae* was collected in Upton, Reagan and Crockett counties, and *gnaphalodes* was collected in Kinney county. *Tagetinae* was collected in Santa Helena Canyon and in the foothills of the Chicos Mountains, in which places it was supposed that *gnaphalodes* should also occur, but it was not found.



## DESCRIPTION OF THE DISEASE

### Symptoms

The symptoms observed in the various outbreaks were quite typical. As a rule the animals were in a good state of flesh and when viewed from a distance, while quiet, they presented a healthy appearance. However, when fleeing before the approach of an observer frequent stumbling occurred. The leaders would frequently fall to the ground and the following animals would pile up on top of the fallen leaders. Since the stumbling occurred with about the same frequency on either rough or smooth ground it was evident that the contour of the land was not directly responsible for this symptom. A sluggish attitude constituted the first evidence of intoxication. The affected animals were unable to keep up with the remainder of the flock, and were frequently observed to cough. A paroxysm of coughing was sometimes followed by vomiting; the vomitus generally being liquid in character and green in color. However, it was not uncommon to find considerable amounts of unchewed food expelled after coughing. There was a green nasal discharge which was probably due to regurgitation through the nostrils, and also a greenish discoloration on the margins of the lips and lower jaws. When permitted to stand without being molested the respiration was about normal, but while being restrained, as is generally the rule with range animals, the respiration and heart action were accelerated. During the initial stages an outbreak was generally viewed with little apprehension, but the rapid spread of the illness through the flock soon focused the owners attention upon the seriousness of the situation.

### Pathology

Upon autopsy no significant macroscopic lesions were observed. Unmistakable evidence of nephritis was found in an occasional animal but as a rule no gross lesions were present. Upon microscopic examination a pronounced albuminous degeneration of the uriniferous tubules was found, a lesion which was much more pronounced than one would anticipate from the post mortem appearance of the kidney. There was pronounced cast formation in the collecting tubules, but the casts did not appear to have completely plugged the tubules. No other lesions were observed.

## RESULTS OF EXPERIMENTAL FEEDING

During the first few weeks of the investigation the plants were collected at weekly intervals and preserved in as fresh a state as possible between collections. This method was required on account of the distance which had to be traveled in order to obtain the plants. Later both species of plants were found growing in abundance near Alpine and daily collections were made. At the beginning of the experiment the sheep ate the plants with reluctance, but this reluctance disappeared in one to three days and both species were eaten with avidity. Ad libitum feeding was practiced,

no additional food being supplied during a feeding period. The results of the feeding trials are summarized in Table 1.

Table 1. Results of feeding *P. gnaphalodes* and *P. tagetinae*

<i>P. gnaphalodes</i>					
Animal	Animal weights	Amount fed	Stage of plants	Feeding period days	RESULTS
S17	Pounds 100	Pounds 111	Young green	Days 50	78 lbs. produced sickness on 33rd day, died on 58th day.
S18	60	174	Young green	80	82 lbs. produced sickness on 30th day, died on the 80th day.
S19	60	80	Young green	51	39 lbs. produced sickness on 23rd day, discontinued. Recovered.
S30	70	224	Mature green	56	Loss of weight, stumbling.
S31	75	408	Mature green	125	Loss of weight.
S32	55	491	Mature green	125	Loss of weight.
G68*	35	319	Mature green	100	Loss of weight.
G69*	20				
<i>P. tagetinae</i>					
S27	70	52	Young green	47	31 lbs. produced sickness on 31st day; feeding discontinued. Recovered.
S28	55	52	Young green	35	43 lbs. produced sickness on 30th day, died on 35th day.
S29	75	25.6	Young dry	28	10.3 lbs. produced sickness on 12th day, died on 28th day.
S19**	70	222	Mature green	57	Loss of weight.

S—Sheep; G—Goat.

\*In addition to the 319 pounds of old plant the goats were fed 37.5 pounds of blooms.

\*\*Fed *P. tagetinae* after it had recovered from the effects of *P. gnaphalodes*.

An examination of Table 1 reveals three outstanding facts; first, that both plants were proven to be toxic; second, that the mature green (blooming stage) was much less toxic than young green or dry plant; third, that a feeding period of several days was required before evidence of toxic effects appeared. It will be noticed that the first evidence of toxicity for both species of the plant appeared in about the same length of time but that fatal results were obtained with *P. tagetinae* in less time than was required to produce fatal results with *P. gnaphalodes*. Relatively large amounts of the older plants were fed without producing marked evidence of poisoning, evidently indicating a decrease in toxicity as the plant approaches maturity. The relative toxicity of the young and old plant is better appreciated when an average of the results is considered. In the case of young *P. gnaphalodes* an average of 121 pounds produced illness or death after an average feeding period of 60 days. In the case of the old plant, 407 pounds were consumed during a feeding period of 91 days without serious effects. In feeding *P. tagetinae* an average of 52 pounds during a feeding period of 41 days produced death in one animal

and serious illness in a second. After feeding 222 pounds of the old growth of this species to one animal during a period of 57 days, very slight evidence of toxicity had occurred when the feeding was discontinued. Further proof of the decreased toxicity of the old plant is to be had in the results with the goats which were fed 319 pounds of *P. gnaphalodes* and 37.5 pounds of blooms during a feeding period of 100 days. A loss of weight constituted the only evidence of ill effects. It is realized that the averages in these cases are obtained from a very small number of animals and therefore not conclusive. These results, however, show definite evidence that there is a decrease in the toxicity of the plants as they approach maturity.

The possibility of a decrease in the toxic content immediately after picking the plants was considered. In order to obtain information on this subject the young growth of *P. tagetinae* was collected in May, thoroughly air dried and kept in this condition until July 12. As shown in Table 1, 26.5 pounds of this dry plant proved fatal to sheep No. 29 in 28 days which is evidence that drying was not particularly detrimental to the toxic principle.

The symptoms produced in the experimental animals were practically identical to those observed on the ranges with the possible exception of coughing. This symptom occurred in the experimentally fed lots with less frequency than under range conditions. In advanced stages stumbling was pronounced, occurring as frequently as four or five times while an animal was running across a sixty-foot enclosure. Regurgitation occurred at frequent intervals but was easily provoked by restraining an animal in a prone position. In restraining the animals in a prone position in order to make close examination, the distress of sick individuals became very noticeable on account of the regurgitation which followed. Although very sick, the animals remained on their feet as long as possible, evidently trying to avoid the distress produced by regurgitation.

The gross and microscopic lesions in the experimental cases differed in no respect from those observed under range conditions. Albuminuria was demonstrated in these cases about as soon as evidence of illness appeared. No injury to the kidneys was detected as a result of feeding the old plants. No change was observed in the total red and white cell content of the blood. There was, however, a 30 per cent. increase in the non-protein nitrogen content of the blood and an increase in the percentage of polymorphonuclear leucocytes as was to be expected in view of the nephritis.

### CONTROL

The fact that the mortalities were confined to certain areas was readily explained as soon as the cause was established. Both species of *Psilostrophe* had a patchy distribution and as a result the worst infested areas were included within certain pastures. In adjacent pastures no growth or at most a scanty growth occurred, which was kept grazed off without ill effects. The fact that both species were patchy in their

distribution and that several days were required to produce poisonous effects were of value in preventing losses from this source. As the losses generally occurred in certain pastures it was possible for a rancher to divide the flock into small bunches and employ a systematic pasture rotation. A small bunch was placed in an infested pasture and allowed to remain there for a period of about two weeks or until such time as a careful observation disclosed the first evidence of intoxication. The sheep were then removed, placed in non-infested pastures and replaced by a fresh bunch. Generally before the entire flock had been grazed on the infested pastures the first bunch had made a complete recovery and the procedure could be repeated, if necessary, since recovery did not appear to sensitize or protect an animal against a second attack. The advent of spring weather sometimes provided a crop of more palatable weeds and thus prevented further losses. However, until more suitable forage appeared these poisonous plants were viewed with considerable apprehension.

### DISCUSSION

The experimental results concerning the time required to produce definite evidence of toxicity does not exactly coincide with range observations. The average time required in the corral feeding was about 27 days whereas on the range definite evidence of toxicity generally appears within three weeks, and it has been observed as early as two weeks from the time the animals were placed in the infested pastures. The results also appear to show that *P. tagetinae* possesses greater toxicity than *P. gnaphalodes*. However, such evidence may represent a variation in the susceptibility of the animals employed in the investigation, as observations on outbreaks on various ranges do not support such a conclusion. One or the other species generally predominate in a certain locality so that it is impossible to make comparisons of the toxicity of the two plants under range conditions. The fact that illness appeared in about the same length of time regardless of the species involved leads us to conclude that the plants should be considered of equal toxicity.

Although experimental results have demonstrated a decreased toxic content in old plants, range observations tend to show that the appearance of blooms does not indicate that these plants are free of toxic principle. Losses were observed in sheep during the middle and late summer months at a time when both species of *Psilostrophe* were in full bloom. The symptoms and histopathology lesions in these cases were quite suggestive of *Psilostrophe* poisoning, and the fact that the plants were being eaten in large amounts and that no other cause for losses could be determined left no other conclusion but that the mature *Psilostrophe* was responsible for these mortalities.

As a general rule the poisonous plants of the southwest are of low palatability and become of importance as sources of live stock losses during unfavorable range conditions. This general rule does not apply in the case of *Psilostrophe*, as both species appear to be quite palatable to

sheep. The fresh succulent growth of these plants appears in the late fall months, shortly after the frosts have killed other green forage. Therefore in some areas the plants are the only succulent food during most of the winter months and are very apt to be grazed in the midst of good winter range. Consequently they may become of importance in sheep losses at any time and especially during the winter months.

The importance of *Psilostrophe* as a poisonous plant for cattle has not been determined. While investigating sheep losses from this source we have frequently obtained histories of light cattle losses which were occurring simultaneously on the same or adjacent ranches. The symptoms which we have observed and which have been reported in these cases have provided reason for suspecting these plants as being responsible for such cattle losses. It is quite evident that both *P. gnaphalodes* and *P. tagetinae* are of low palatability for cattle, but nevertheless are occasionally grazed.

Further studies are required in order to classify these plants in regard to their toxicity for both cattle and goats. The results of such investigations will be reported at some later date.

### SUMMARY

1. Extensive sheep losses in the Trans-Pecos area were proved to be due to the eating of *P. gnaphalodes* and *P. tagetinae*.
2. Symptoms of poisoning did not appear until about three weeks after sheep began to eat the plants.
3. Old plants (blooming stage) were found to be less toxic than younger plants.
4. As a rule these plants were generally confined to certain pastures. By rotating sheep from infested to non-infested pastures serious losses were prevented.