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Allelopathy in Mesquite (*Prosopis juliflora*): A lausible Factor in Invasiveness and Dominance of the Species

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Abstract

Common mesquite (*Prosopis juliflora*), a Fabaceae, native to South America, was first introduced into Sudan in 1917 to curb desertification. However, the plant has spread and become a weed of national importance and a threat to biodiversity. The present investigation was undertaken at the College of Agricultural Studies, Sudan University of Science and Technology to study allelopathic potentials of mesquite, and activity and persistence of the allelochemicals in soils. In all experiments lettuce (*Lactuca sativa* L.) was used as a test plant. Powdered mesquite parts including leaves, stems, barks and pods, showed differential effects on lettuce seed germination and seedlings growth. Germination was the least affected. Seedlings growth was affected negatively. The radicle was more sensitive to the toxins than the hypocotyl. Mesquite pods were the most suppressive followed in descending order by bark, leaves and stems. Toxins were active through soil and their persistence progressively declined with time. The results suggest that mesquite parts contain water-soluble allelochemicals and that allelopathy may contribute, considerably, to the invasive nature of the plant and its dominance.

Keywords: Allelochemicals, biodiversity, desertification, invasive plants, hypocotyls and radicle length,

Introduction

Common mesquite *P. juliflora*, an evergreen leguminous tree or shrub native of South America, was introduced into several countries including India, Kenya and South Africa to combat desert encroachment (Burkart, 1976; Mwangi, 2005). The plant was introduced into Sudan in 1917 (Broun and Massey 1929). Furthermore, it was re-introduced from different sources several times in the period 1970–1985 (Babiker, 2006). However, because of resilience and invasive nature, conferred by copious seed production, ease of dissemination, unpalatability of leaves and high coppicing ability, the plant has spread where not desired, suppressed native vegetation and often forms dense virtually monospecific stands that interfere with land use, lower productivity of grazing enterprises and interfere with mustering of stocks (Elsidig *et al.*, 1998). The obnoxious nature of mesquite and its potential threat to agriculture, pastoralism and biodiversity in Sudan was recognized in the 1980s (El Houri, 1986). Factors related to the proliferation of *Prosopis* in Sudan are repeated introductions, deliberate distribution, prevailing drought, livestock and feral animal`s movement, decreased land-use, overexploitation of natural vegetation and floods (Babiker, 2006).

The plant is more of a problem within Eastern, Central and Northern Sudan. Currently mesquite infestation is estimated to cover over 400 thousand hectares the bulk (>90%) of which is in Eastern Sudan, where livestock keeping and subsistence farming are the main sources of income (Babiker, 2006). The increase and spread of *P. juliflora,* which was observed subsequent to the 1990s, is in line with reports on spread of various invasive alien weeds. Many noxious invasive alien plants were reported to remain quiescent, or display a lag phase, following introduction (Mashhadi and Radosevich 2004). The length of the lag phase is determined by both intrinsic factors related to the plant and extrinsic factors related to the environment (Mashhadi and Radosevich 2004). The drought, which has been experienced by the Horn of Africa since the 1970s, is perhaps a major element in the spread of mesquite as the plant is drought tolerant and a nitrogen fixer at the seedling stage (Babiker, 2006). Furthermore, the plant is endowed with extensive root system comprising of a taproot and laterals. The former grows deeply into soil and may connect with underground aquifers, while the latter forages nutrients and rain water from the surface soil and compete effectively with shallow rooted grasses (Pasiecznik *et al.*, 2001).

Suppression and/or replacement of native vegetation by mesquite together with the high tendency to form monospecific stands suggest, at least in part, involvement of allelopathy in interference of mesquite with native vegetation. Such a phenomenon may play a major role, as noted with other alien invasive plants, in mesquite spread and ability to suppress native vegetation (Nakano *et al.* 2003). Furthermore, allelochemicals from mesquite may impair its subsequent replacement by other plants. Replacement of invasive alien weeds, after removal by native plants, is a fundamental component of their effective management strategies.

Mesquite, when exotic, has been reported to be a threat to biodiversity and to inhibit germination and growth of many plant species growing in its vicinity through allelopathic substance(s) exuded from its leaves, roots or fruits (Al-Humaid and Warrag 1998). However, in its native range mesquite was reported to facilitate biodiversity (Kaur, *et al*. 2012). However, most allelochemicals are secondary compounds and their productions and distribution in plants as well as their activity and persistence in soils are influenced by environmental conditions (Pickett, *et al*., 2013).

The present investigation was therefore set to study allelopathic potentials of different mesquite parts and activity and persistence of allelochemicals from mesquite in soil.

Materials and Methods

A series of laboratory experiments was undertaken at the College of Agricultural Studies Sudan University of Science and Technology in the period February 2011 to October 2012. The objectives of the experiments were to screen different parts of *P. juliflora* for allelopathic effects and determine activity and persistence of allelochemicals in mesquite leaves in soil.

Collection and Preparation of Samples

Mesquite parts comprising leaves, stems, bark and pods were collected from trees growing in the premises of the College of Agricultural Studies Shambat (Latitudes15º39′32.05"N and longitudes 32º31′48.28"E). The mesquite parts were collected, dried under shade at ambient temperature, ground, powdered and kept at ambient temperature till used.

Allelopathic Activity of Mesquite Parts

The agar sandwich method described by Fujii, (2003, 2004) was used for assessment of allelopathic effects. The method resides on diffusion of toxicants from plants into agar. Briefly, agar, nutrient-less (3.5g), was added to 1000 ml of distilled water and autoclaved for 20 min at 15 bar and 121 °C. The agar was allowed to cool in a water bath set at 40 °C prior to use. The agar was pipetted into multi-well plastic plates (5 ml/well), and allowed to solidify prior to placement of the respective test sample on top. Another 5 ml of agar were placed on top, allowed to solidify, and subsequently lettuce seeds (5 per well) were placed and pressed gently to ensure contact with the medium. The multi-well plates, cover in place, sealed with Parafilm and wrapped in aluminum foil, were incubated at 25 °C in the dark for 72 h prior to examination for germination and measurement of radicle and hypocotyl length. Treatments, replicated five times each, were arranged in complete randomized design. Controls, without mesquite were included for comparison.

Effects of soil on activity of allelochemical(s) from mesquite leaves

Samples of mesquite leaves powder (0-150 mg) were mixed, each, with 100 g soil collected from a mesquite free neighboring area. Samples of the mix (3 g each) were assayed for toxicity as previously described for mesquite parts. Untreated soil was included as a control for comparison.

Persistence of allelochemical(s) from mesquite leaves in soil

Mesquite leaves were collected, air-dried, ground, powdered as mentioned above and kept at room temperature till used. The leaves powder (1.7 and 2.5 g) mixed with soil to make a total of 100 g each, was placed in plastic pots (7 cm diam.). Soil moisture was adjusted to field capacity (40% v/w) with distilled water 45, 30, 15 and 7 days prior to termination of the experiment. Each treatment was replicated five times. The samples were weighed and incubated in the dark at 20 °C. Water loss was replenished by bringing the plastic cups and their contents back to original weight every 2 - 3 days. At termination the soil samples were air-dried, mixed thoroughly by hand and samples (3 g each) were assayed for toxicity using the sandwich method as above. Untreated soil and soils treated with mesquite leaves powder at 1.7 or 2.5 g/ 100 g at termination were included as controls for comparison.

Statistical Analysis

Data were recorded, expressed as percentage of the respective control and subjected to analysis of variance using Microsoft Excel as described by Fujii *et al*., (2003, 2004), and automatically analyzed and means and standard deviation were calculated (Iqbal *et al*., 2003).

Results

Effects of Mesquite Parts on Lettuce Seeds Germination and Seedlings Growth Effects on Germination

Powders from different parts of mesquites displayed differential inhibitory effects on Lettuce seed germination (Table 1).

Table 1: Effects of mesquite parts on germination of lettuce

	Germination (%)			
	Mesquite parts			
Powder (mg/well)	Bark	Leaves	Stem	Pods
5	93.3 ±11.5	-	100.0 ±0.0	100.0 ±0.0
10	93.3 ±11.5[1]	93.3 ±11.5	100.0 ±0.0	93.3 ±11.5
20	86.7 ±11.5	93.3 ±11.5	93.3 ±11.5	86.7 ±23.1
30	66.7 ±13.5	93.3 ±11.5	93.3 ±11.5	46.7 ±30.6
40	66.7 ±30.5	93.3 ±11.5	93.3 ±11.5	06.7 ±11.5
50	66.7 ±30.5	93.3 ±11.5	93.3 ±11.5	0.0 ±0.0
75	60.0 ±20.0	86.7 ±11.5	66.7 ±11.5	-
100	26.7 ±11.5	80.0 ±0.0	86.7 ±11.5	-
150	20.0 ±20.0	73.3 ±11.5	53.3 ±23.1	-

[1]± standard deviation

Mesquite bark powder at 5 – 20 mg/well resulted in a slight inhibition of germination (6.7 - 13.3 %) (Table1). Raising powder concentration to 30 and 50 mg/well caused considerable inhibition of germination (33.3 %). A further increase in powder concentration to 75, 100 and 150 mg/well inhibited germination by 40, 73.3 and 80 %, respectively. Germination exhibited negative correlation with the amount of powder used (r = - 0.58, P ≤ 0.001)

Powder of dry leaves, collected from under trees, at 10 mg/well suppressed lettuce germination by 6.7 % (Table 1). An increase in amount of powder up to 50 mg/well did not further reduce germination. A further increase in powder to 75, 100 and 150 mg/well reduced germination by 13.3, 20 and 26.7%, respectively. Germination showed negative correlation with the amount of powder used (r = - 0.38, P ≤ 0.002).

Mesquite stem powder at 5 and 10 mg/well had no effect on lettuce seed germination (Table. 1). Increasing powder concentration to 20-50 mg/well resulted in negligible (6.7%) reductions in germination. An increase in powder concentration to 75 and 100 mg/well reduced germination by 33.7 and 13.3%, respectively. A further increase in powder concentration to 150 mg reduced germination by over 47%. Germination displayed a negative correlation with the amount of powder used (r = - 0.51, P ≤ 0.001)

Mesquite pods powder, showed differential inhibition of lettuce germination. At 5 mg/well pods powder had no effect on germination (Table 1). A slight suppression (6.7%) in germination was displayed at 10 mg/well. Mesquite pod powder at 20 and 30 mg/well reduced germination by 13.3 and 53.3 %, respectively. A further increase in powder concentration to 40 and 50 mg/well reduced germination to 6.7 and 0 %, respectively. Germination showed negative correlation with the amount of powder used (r = - 0.82, P≤002)

Effects of Soil on Activity of Toxins from Mesquite Leaves (assayed by lettuce Seed germination):

Mesquite Leaves powder at 25 mg/3g soil suppressed germination, albeit not significantly (Table 2). An increase in powder amount to 50 mg/3g soil decreased seed germination by 26.7 %. A further increase in amount of powder to 75 and 100 mg/3g soil reduced germination by 73.3 and 66.7 %, respectively. Increasing amount of powder to 150 mg/3g soil resulted in complete inhibition of germination.

Table 2: Effects of soil on activity of toxins from mesquite leaves (assayed by lettuce seed germination)

Leaf powder mg/3g soil	Germination (%)
25	93.9 ±11.5
50	73.3 ±11.5
75	26.7 ±11.5
100	33.3 ±11.5
150	0.0 ± 0.0

± standard deviation

Effects on Seedlings Growth: Powder of dry leaves collected from under mesquite trees reduced lettuce seedlings growth in a concentration dependent manner. Dry leaves powder at 10 mg/well inhibited radicle growth by 79 % (Table 3). At 20 - 50 mg dry leaves /well radicle growth was further reduced by 82 – 90 %. A further increase in amount of leaves powder to 75 - 150 mg/well inhibited radicle growth by over 95 %. Hypocotyl growth was, however, less sensitive to inhibitors from mesquite leaves. Mesquite dry leaves powder at 10 mg/well inhibited hypocotyl growth by 18 %. Increasing powder amount to 20 – 50 mg reduced hypocotyl growth by 48 – 64 %. At 75, 100 and 150 mg/well hypocotyl growth was reduced by 81, 84 and 92 %, respectively (Table 3).

Table 3: Effects of mesquite dry leaves powder on lettuce seedling growth

Powder (mg/well)	Radicle (growth %)	Hypocotyl (growth %)
Control	100 ±0.45	100 ±1.53
10	21 ±2.91	82 ±4.35
20	18 ±2.33	52 ±2.52
30	10 ±0.58	43 ±1.15
40	10 ±0.69	38 ±0.58
50	10 ±0.33	36 ±0.77
75	4 ±0.51	19 ±1.50
100	7 ±0.84	16 ±0.51
150	3 ±0	8 ±0.33

± standard deviation.

Mesquite stem powder at 5 mg/well decreased radicle growth by 60 %. At 10, 20, 30, 40 and 50 mg/well radicle growth was inhibited by 77, 80, 85, 82 and 89 %, respectively (Table 4). A further increase in amount of powder to 75 mg/well or more reduced radicle length by over 90 %. Stem powder at 5 mg/well stimulated hypocotyl growth significantly (Table 4). The powder at 10–50 mg/well reduced hypocotyl growth by 13–51 %. A further increase in powder concentration to75 mg/well reduced hypocotyl growth by 74 %, respectively. Raising amount of powder to 100 and 150 mg/well showed no further consistent reductions in hypocotyl growth (Table 4).

Table 4: Effects of mesquite stem powder on lettuce seedling growth

Powder (mg)	Radicle (growth %)	Hypocotyl (growth %)
Control	100 ±0.45	100 ±1.53
5	40 ±4.62	121 ±1.17
10	23 ±1.02	87 ±1.02
20	20 ±3.86	79 ±3.20
30	15 ±1.35	73 ±4.74
40	18 ±0.51	73 ±1.15
50	11 ±0.51	49 ±1.53
75	6 ±0.38	26 ±1.54
100	9 ±0.19	42 ±0.84
150	4 ±0.84	21 ±2.52

± standard deviation.

Mesquite bark powder at 5 mg/well reduced lettuce radicle growth by 36% (Table 5). An increase in powder concentration to 10, 20, 30 and 40 mg/well reduced radicle length by 55, 80, 83, and 89 %, respectively. A further increase in powder concentration to 50 or more resulted in over 95 % reduction in radicle growth (Table 5). Park powder at 5 mg/well reduced hypocotyl growth by 17 %. Increasing powder concentration to 10 and 20 mg/well reduced growth by 37 and 64 %, respectively. A further increase in bark powder to 40 mg/well or more reduced hypocotyl growth by over 80 % (Table 5)

Table 5: Effects of mesquite dry bark powder on lettuce seedling growth

Powder (mg)	Radicle (growth %)	Hypocotyl (growth %)
Control	100 ±0.45	100 ±1.53
5	64 ±1.53	83 ±0.69
10	45 ±1.70	63 ±1.64
20	20 ±0.88	36 ±1.71
30	17 ±2.60	35 ±1.02
40	11 ±0.51	15 ±0.84
50	3 ±1.67	8 ±0.19
75	2 ±0.38	13 ±1.0
100	1 ±0.19	6 ±0.33
150	0 ±0.19	1 ±0.38

± standard deviation.

Mesquite pods powder showed considerable inhibition of lettuce seedlings growth. Mesquite pod powder at 5 and 10 mg/well inhibited radicle growth by 85 and 90 %, respectively (Table 6). Increasing powder concentration to 20 and 30 mg/well reduced radicle growth by 94%. A further increase in pods powder to 40 and 50 mg/well resulted in complete inhibition of radicle growth. Lettuce hypocotyl was less sensitive to toxins from mesquite pods. At 5 mg/well pods powder, hypocotyl growth was reduced by 46 %. Increasing pods powder to 10 mg/well resulted in a sharp decrease in hypocotyl growth. A further increase in amount of powder to 20 and 30 mg/well reduced hypocotyl growth by 80 and 86 %, respectively. An increase in powder amount to 40 mg/well or more completely inhibited hypocotyl growth (Table 6).

Table 6: Effects of mesquite pods powder on lettuce seedling growth

Powder (mg)	Radicle (growth %)	Hypocotyl (growth %)
Control	100 ±0.45	100 ±1.53
5	15 ±1.07	54 ±1.67
10	10 ±0.69	28 ±2.50
20	6 ±0.38	20 ±0.84
30	6 ±1.95	14 ±1.84
40	0 ±0.19	1 ±0.38
50	0 ±0	0 ±0

± standard deviation.

Effects of Soil on Activity of Toxins from Mesquite Leaves (assayed by lettuce seedlings growth): Mesquite leaves powder mixed with soil showed considerable toxicity to lettuce (Table 7). At 25 and 50 mg/3g soil radicle growth was reduced by 52 and 82 %, respectively. A further increase in leaves powder to 75 mg/3g soil or more decreased radicle growth by over 95 %. Hypocotyl growth on the other hand, was less sensitive to toxins from mesquite leaves. At 25 and 50 mg/3g soil hypocotyl growth was reduced by 12 and 46 %, respectively. Mesquite leaves powder at 75 mg/3g soil or more reduced hypocotyl growth by over 80 % (Table 7).

Table 7: Effects of soil on activity of toxins from mesquite leaves assayed by lettuce seedlings growth

Powder (mg)	Radicle (growth %)	Hypocotyl (growth %)
Control	100 ±0.45	100 ±1.53
25	48 ±1.50	88 ±3.50
50	18 ±1.20	54 ±2.70
75	2 ±0.20	16 ±2.40
100	3 ±0.60	15 ±3.3
150	0 ±0	0 ±0

± Standard deviation.

Persistence of Toxins From Mesquite Leaves in Soil.

Persistence of toxins from mesquite leaves in soil showed dependence on application time and was less dependent on concentration (Table 8.). Leaves powder at 1.7 g/100 g soil applied at termination of the experiment reduced radicle growth by 38 %. Treatments made 7, 15, or 30 days prior to termination reduced radicle length by 28, 20 and 15 %, respectively, while treatment made 45 days prior to termination displayed negligible effects. Hypocotyl growth showed more or less similar trends (Table 8).

Table 8 A: Persistence of toxins from mesquite leaves in soil [assayed by lettuce seedlings growth (1.7g leaves powder/100g soil)].

Days	Radicle (growth %)	Hypocotyl (growth %)
Control	100 ±0.84	100 ±1.00
0	62 ±0.50	69 ±0.20
7	72 ±1.30	77 ±1.20
15	80 ±1.20	84 ±1.50
30	85 ±0.40	90 ±1.50
45	96 ±2.50	98 ±1.50

± Standard deviation

Table 8 B: Persistence of toxins from mesquite leaves in soil [assayed by lettuce seedlings growth (2.5g leaves powder/ 100g soil)]

Days	Radicle (growth %)	Hypocotyl (growth %)
Control	100 ±0.84	100 ±1.00
0	57 ±0.30	65 ±0.30
7	69 ±1.30	74 ±1.00
15	77 ±0.30	80 ±0.50
30	81 ±0.60	86 ±0.90
45	92 ±0.50	95 ±1.00

± Standard deviation

At 1.7 g/100 g soil, treatments made 45, 30, 15, 7 days prior to and at termination reduced hypocotyl growth by 2, 10, 16, 23 and 31 %, respectively. Increasing concentration of mesquite leaves powder to 2.7g/100 g soil showed more or less similar trends. Treatments made 45, 30, 15, 7 days prior to and at termination reduced radicle growth by 8, 19, 23, 31 and 43 %, respectively. On the other hand, hypocotyl growth was reduced by 5, 14, 20, 26 and 35 %, respectively (Table 8).

Discussion

The results revealed that mesquite contains toxins, which impaired germination and growth of lettuce seedlings (Tables 1-8). However, the toxicity varied with the mesquite part employed, the concentration used, and the exposed parts of the receiver plant. In general, germination was the least affected (Tables 1 and 2) and the test plants radicle was invariably the most sensitive to the toxins (Tables 3-8). The toxins are widely distributed in all the plant parts tested. However, among mesquite parts evaluated for toxicity, pods caused the highest suppression of both germination and seedlings growth (Fig. 1 - 6). These finding corroborate the observations made by AL-Humaid and Warrag (1998), Nakano *et al.*, (2003) and Ahmed (2009). AL-Humaid and Warrag (1998) and Nakano *et al.*, (2003) reported toxins from mesquite leaves leachates while Ahmed (2009) reported that mesquite pods contain inhibitors that modulate mesquite germination and growth.

The above results (Tables 1-8) confirmed the previously reported allelopathic effects of mesquite and suggest that in addition to the competitive effects conferred by its rapid growth (Inderjit, 2010), phreatic nature and lack of natural enemies (Babiker, 2006), allelopathy may be playing a major role in the ability of the plant to suppress and replace indigenous vegetation. This suggestion is in line with the novel weapon hypothesis, which is advocated to explain the rapid spread, dominance and the contradictory ecological impact of alien invasive plants (Inderjit, 2010). Several invasive alien plants including *P. juliflora* were reported to have facilitative effects on biodiversity in their native range. However, when exotic, they were reported to have strong negative effects on species richness (Kaur, *et al.,* 2012).

The results on effects of soil on activity of toxins from mesquite (Table 7 and 8) showed that toxins from mesquite could be effective as soil retardants to growth of other plants. Furthermore, the toxins are degradable and their persistence in soil is influenced by soil moisture and time (Table 8). Toxicity was maximal for treatments made at termination and minimal for those made 45 days earlier.

In the present investigation, no attempt was made to identify the allelochemicals produced by mesquite or their transformation products in soil. However, the data on allelopathic effects of mesquite parts and persistence of toxins from mesquite is of interest with regard to replacement of mesquite by other plants as part of an integrated management strategy. The study, unequivocally, showed that mesquite parts contain allelochemicals that suppress growth of lettuce seedlings and the allelochemicals produced are active in soils and display adequate persistence. Furthermore, the study calls for screening more plants for tolerance and susceptibility to toxins from mesquite leaves and/or litter. Such studies are relevant for probing the feasibility of using mesquite harvest residues as potential tools for weed control in selected crops. This notion is of practical significance in rural areas where mesquite is abundant and agroforestry is practiced. Studies on soil dilution of the toxins through ploughing and/or enhancement of toxins degradation by pre-irrigation are also relevant. Both pre-irrigation and soil dilution through ploughing are commonly used for reducing toxicity of herbicides residues in soil and could be useful in decreasing toxicity of mesquite litter and facilitate growth of plants intended to replace mesquite in an integrated management approach.

Conclusions:

- The mesquite parts examined, leaves, stems, bark and pods, contain water soluble allelochemicals that negatively affect germination and growth of lettuce. The alleochemicals from pods were the most suppressive to lettuce germination and growth.
- The suppressive effects of alleloch-emicals from mesquite, suggest that allelopathy may contribute, at least in part, to the invasive nature of the plant and its dominance.
- The allelochemicals from mesquite were degradable in soil. However, their adequate persistence merits further probing their potentials for weed control in rural areas where mesquite is abundant and agroforestry is practiced.

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التضاد البيئي في شجرة المسكيت: عامل في سيطرة و هيمنة النوع

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المستخلص

أُدخل نبات المسكيت في السودان عام 1917م لمنع الزحف الصحراوي، يعتبر من نباتات العائلة البقولية و موطنه الأصلي في أمريكا الجنوبية. عموما، إنتشر المسكيت و أصبح يمثل مشكلة قومية و ذلك لدخوله في المشاريع الزراعية، المروية والمناطق الرعوية، إضافة لتأثيره على التنوع الحيوي بالمناطق المختلفة. أُجريت هذه الدراسة بكلية الدراسات الزراعية، جامعة السودان للعلوم و التكنولوجيا و ذلك بغرض دراسة أثر الأجزاء المختلفة لنبات المسكيت على إنبات بذور و نمو نبات الخس كنباتات إختبار، تراكم المادة الكيميائية الموجودة في أشجار المسكيت داخل التربة تحت الظروف الطبيعية ونشاطها و أثرها المتبقي في التربة. أظهر مسحوق الأجزاء المختلفة لشجرة المسكيت و التي تشمل الأوراق، الساق، اللحاء و قرون الثمار تأثيرا متباينا على إنبات و نمو نبات الخس. كانت نسبة الإنبات أقل تأثراً من بين كل القياسات. و تأثرت نسبة نمو البادرات، متمثلة في طول الجُذير و المنطقة تحت الفلقية للبادرة سلبا، حيث إعتمد التأثير على تركيز المسحوق في أغلب الأحيان. كان جذير بادرة نبات الخس دائما ذو قابلية أكثر للتأثر بالمواد السامة لأجزاء شجرة المسكيت من المنطقة تحت الفلقية للبادرة. من بين أجزاء المسكيت كانت قرون الثمار الأكثر سمية متبوعة تنازلياً باللحاء، الأوراق الجافة المتساقطة ثم الساق. ظهرتأثير للمواد السامة لأوراق المسكيت من خلال التربة. علاوة على ذلك، تأثرت فترة بقاء السموم زمنياً. نشاط الأوراق أكثر سمية عندما تم إختبارها بعد المعاملة مباشرة وإختفى معظم النشاط (> 90 %) خلال 45 يوماً. من خلال النتائج يُعتقد أن السمية الناتجة من أجزاء شجرة المسكيت قد تشرح و لو جزئياً إنتشار المسكيت وتسيده.