

TAXONOMY OF THE GENUS NANORRHINUM (SCROPHULARIACEAE) IN IRAN

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Taxonomy of the tribe *Antirrhineae* belonging to *Scrophulariaceae* family with the exception of the genus *Linaria* was studied in Iran by the first author. Taxonomic results are showing that the genus *Nanorrhinum* is an independent genus, formerly was known as a synonymy of *Kickxia* section *Valvatae*. In this paper the genus *Nanorrhinum* in Iran is revised. *Nanorrhinum khuzestanicum* and *N. baluchestanicum* are described as new species from Khuzestan and Baluchestan provinces. These new species are compared with their closest relatives' *N. chasmophyticum* and *N. campyloceras* that are new combinations. These two combinations are based on *Kickxia chasmophytica* and *Linaria campyloceras* respectively.

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Key words. *Nanorrhinum*, *Scrophulariaceae*, Taxonomy, revision, New species, seed, Iran.

تاکسونومی جنس *Nanorrhinum* از تیره *Scrophulariaceae* در ایران

صدیقه یوسف نعنایی، کارشناس مرکز تحقیقات کشاورزی و منابع طبیعی استان خوزستان.
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قبیله *Antirrhineae* (*Scrophulariaceae*) به استثنای جنس *Linaria* در ایران بررسی شد. نتایج تاکسونومیک این بررسی شامل معرفی جنس مستقل *Nanorrhinum* بود که با بخش *Valvatae* از جنس *Kickxia* مترادف شناخته شده بود. در این مقاله جنس *Nanorrhinum* مورد بررسی تاکسونومیک قرار می گیرد. دو گونه جدید به نامهای *Nannorrhinum khuzestanicum* و *N. baluchestanicum* از این جنس برای اولین بار معرفی می گردند. دو ترکیب جدید نیز به نامهای *N. chasmophytica* و *N. campyloceras* بر اساس نامهای پایه *Kickxia chasmophytica* و *Linaria campyloceras* معرفی می شوند.

Introduction

The first author revised the tribe *Antirrhineae* (*Scrophulariaceae*) for the Flora of Iran (Assadi 1989). Tribe *Antirrhineae* has a complex taxonomic history with considerable variation in the size and interpretation of the genera (Sutton 1988). It has been treated as a single genus, as a tribe or as a subfamily. Linnaeus (1753) only described the single genus *Antirrhinum* for the complex. Chavannes (1833) considered that this could be subdivided into 6 genera. Sutton (1988) accepted 27 genera and 328 species that *Kickxia* Dumort, is a genus of 46 species belonging to tribe *Antirrhineae*. He divided this genus into 2 sections, sect. *Kickxia* with operculate capsule and sect. *valvatae* with valate capsule dehiscens. He recognized

9 species in sect. *Kickxia* and 37 species in sect. *Valvatae* (Sutton 1988). These two sections were formerly recognized by Wettstein (1891) based on capsule dehiscens, sect. *Operculatae* for operculate capsules and sect. *Valvatae* for valvate capsules in the genus *Elatinoides*. They were treated as *Kickxia*, sect. *Kickxia* (as sect. *Operculatae*) and *K. sect. Valvatae* by Janchen (1933). These two sections show marked differences and a subdivision into distinct genera has been proposed by Betsche (1984). Sect. *Kickxia* treated as the genus of *Kickxia* and sect. *Valvatae* divided into 2 separate genera, *Pogonorrhinum* and *Nanorrhinum*. Sutton (1988) did not recognize this division and instead recognized one genus with two sections.

Phylogenetic relationships within the tribe *Antirrhineae* were analysed on the basis of parsimony analyses of morphological and *ndhF* gene sequence data, showed that the two sections of *Kickxia* are sister groups and genus as circumscribed by Sutton (1988), appears to be monophyletic (Ghebrehiwet et al. 2000).

Phylogenetic studies in *Kickxia* sensu lato, using morphological characters, show that the two groups of species appear as distinct clades. The differences between the two sections are of the same magnitude as those used to separate other closely related genera in the tribe. Therefore, the treatment of the sect. *Valvatae* as a separate genus, *Nanorrhinum* did by Ghebrehiwet (2001).

Naanaie (2004) prepared a phenogram of the *Kickxia* complex in Iran. Phenetic relationships among the species were analyzed using a morphological data including 39 characters and 16 taxa. Four of the species appeared in a cluster at generic level having characters of the genus *Nanorrhinum* (not published). The aim of the present study is to revise the taxonomy of these four species under the genus *Nanorrhinum*. It seems further studies are needed to clear taxonomic position of other taxa treated by Sutton (1988) as *Kickxia* sect. *valvatae* but not included in the revision of Ghebrehiwet (2001).

Material and methods

This study is mainly based on the rich herbarium materials of mainly TARI and IRAN herbaria and also field observations. Several taxonomic treatments including Sutton (1988), Ghebrehiwet et al. (2000), Ghebrehiwet (2001) were used for the identifications. For Scanning Electron Microscopy, dry seeds were mounted directly on using conductive silver paint, and coated with gold in sputter coater. Morphological observations were made in GXA-84 Scanning Electron Microscopes.

Results and discussion

The genus *Nanorrhinum* is recognized as a distinct genus and it may be separated from the closely related genera *Linaria* and *Kickxia* in the following key. Four species including two new combinations and two new species are recognized for the *Nanorrhinum* Betsche in Iran. A key to the species is prepared. The species are illustrated and micrographs of the seeds are presented (Fig. 1).

Key to genera *Kickxia*, *Nanorrhinum* and *Linaria*

1. Fertile stamens 2 or 4; anthers free or marginally coherent in pair, not forming ring-like structure. Leaves

entire, pinnately veined, sessile or shortly petiolate. Seeds with up to 3 longitudinal ridges or encircling wings

1. *Linaria*

-Fertile stamens 4. Anthers marginally coherent, forming ring-like structure. Leaves often hastate or sagittate. Seeds with narrowly columnar tubercles and recurved papilla at the apex or reticulate-faveolate 2

2. Anthers ciliate. Capsule dehiscence operculate; seeds reticulate-faveolate

2. *Kickxia*

-Anthers glabrous. Capsule dehiscence, valvate; seeds with narrowly columnar tubercles and recurved papilla at the apex

3. *Nanorrhinum*

Nanorrhinum Betsche, Cour. Forch. Inst. Senckenbergf 71: 131 (1984).

Syn.: *Elatinoides* sect. *Valvatae* Wettstein in A Engler & K. Prantl, *Naturalischen Pflanzen Familien* ed. 1 4 (3b): 58 (1897); *Kickxia* sect. *Valvatae* (Wettst.) Janchen, *Osterr. Bot. Zeitschr.* 82 (1-2): 152 (1933).

Dwarf shrubs or perennial herbs, erect or procumbent, glabrous, glandular or eglandular. Leaves homomorphic or hetromorphic, entire or sometimes dentate or lobed, linear, ovate, orbicular-cordate, deltoid, sagittate, acute to obtuse, petiolate to subsessile. Inflorescence racemose. Flowers zygomorphic, solitary, pedicelled. Calyx deeply divided, 5 lobed; lobes entire, more or less equal, imbricate, usually shorter than the corolla tube. Corolla yellow or brownish yellow; tube more or less cylindrical or somewhat campanulate; limb 2 lipped; the lips conspicuously unequal or subequal; abaxial lip with low basal palate partially occluding mouth of the tube; palate glabrous to lanate internally. Fertile stamens didynamous included; anthers marginally connate forming a ring. Staminode reduced. Style simple; stigma capitate. Capsule subglobose, ovoid or oblong ovoid, valvately dehiscent with 1-3 (6) teeth; locules equal, many seeded, abaxial locule smaller and dehiscing after the adaxial locule. Seeds oblong-ovoid, ellipsoid or rarely reniform, with rounded to columnar tubercles or with narrowly columnar tubercles and recurved papilla at the apex

Key to the species

1. Plant cushioned, up to 6 cm high

4. *N. chasmophyticum*

- Plants not cushioned, higher than 15 cm 2

2. Plant appearing leafless. Leaves linear or linear-lanceolate, attenuate and gradually petiolate at base

1. *N. campyloceras*

- Plants with clearly leafy stems. Leaves with distinct blades and petioles; blades truncate or cordate at base, often sagittate 3

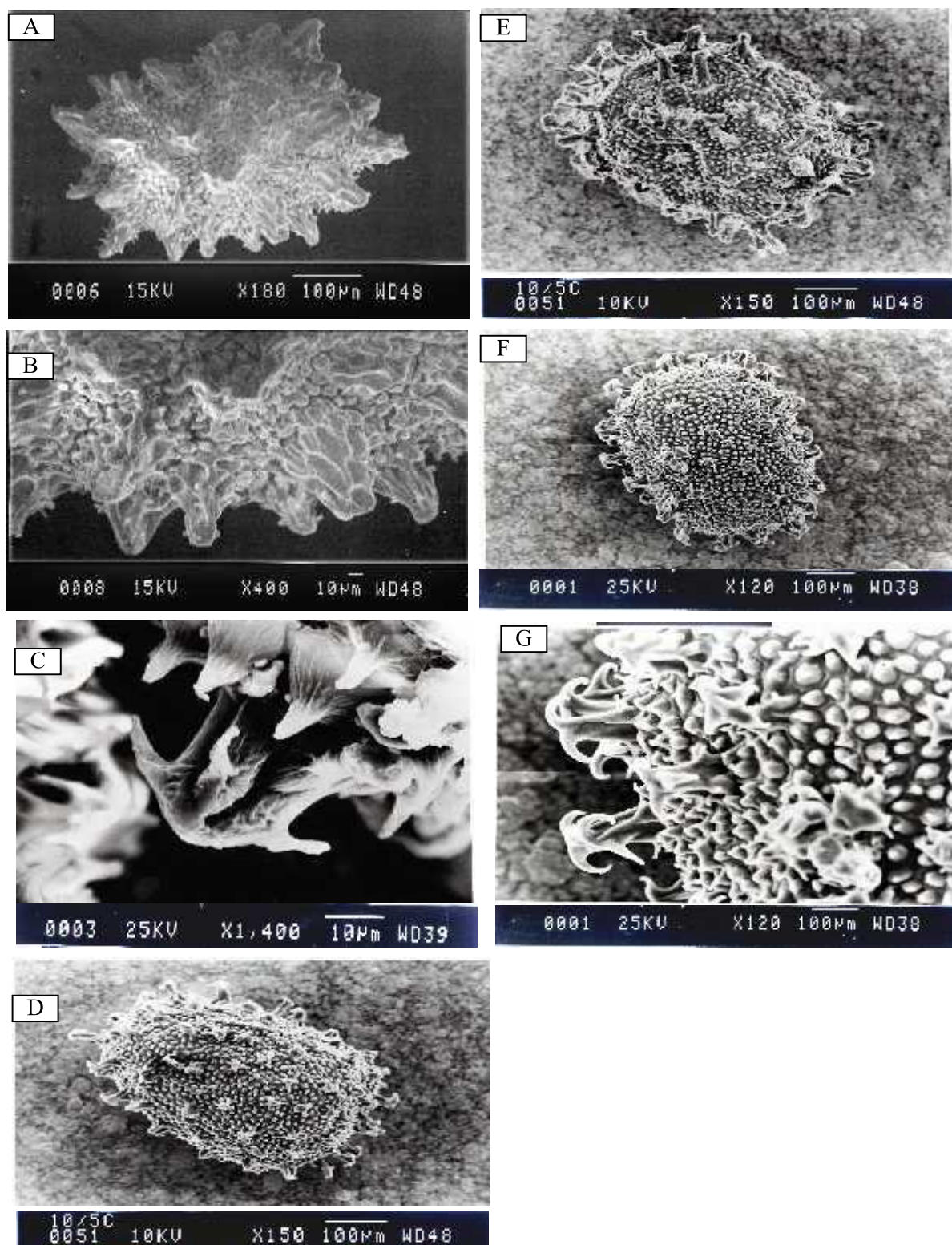


Fig. 1: Micrographs of seed of *Nanorrhinum*: A-B: *N. khuzestanicum* (Naanie 6554); C: *N. chasmophyticum* (Wendelbo & Foroughi 15400); D: *N. baluchestanica* (Ghahreman & Mozaffarian 52845); E: *N. baluchestanica* (Ghahreman & Mozaffarian 58749); F-G: *N. campyloceras* (Assadpour, without number). Scale bare: A=100 µm, B=10 µm, C=10 µm, D=100 µm, E-F=100, G =100 µm.

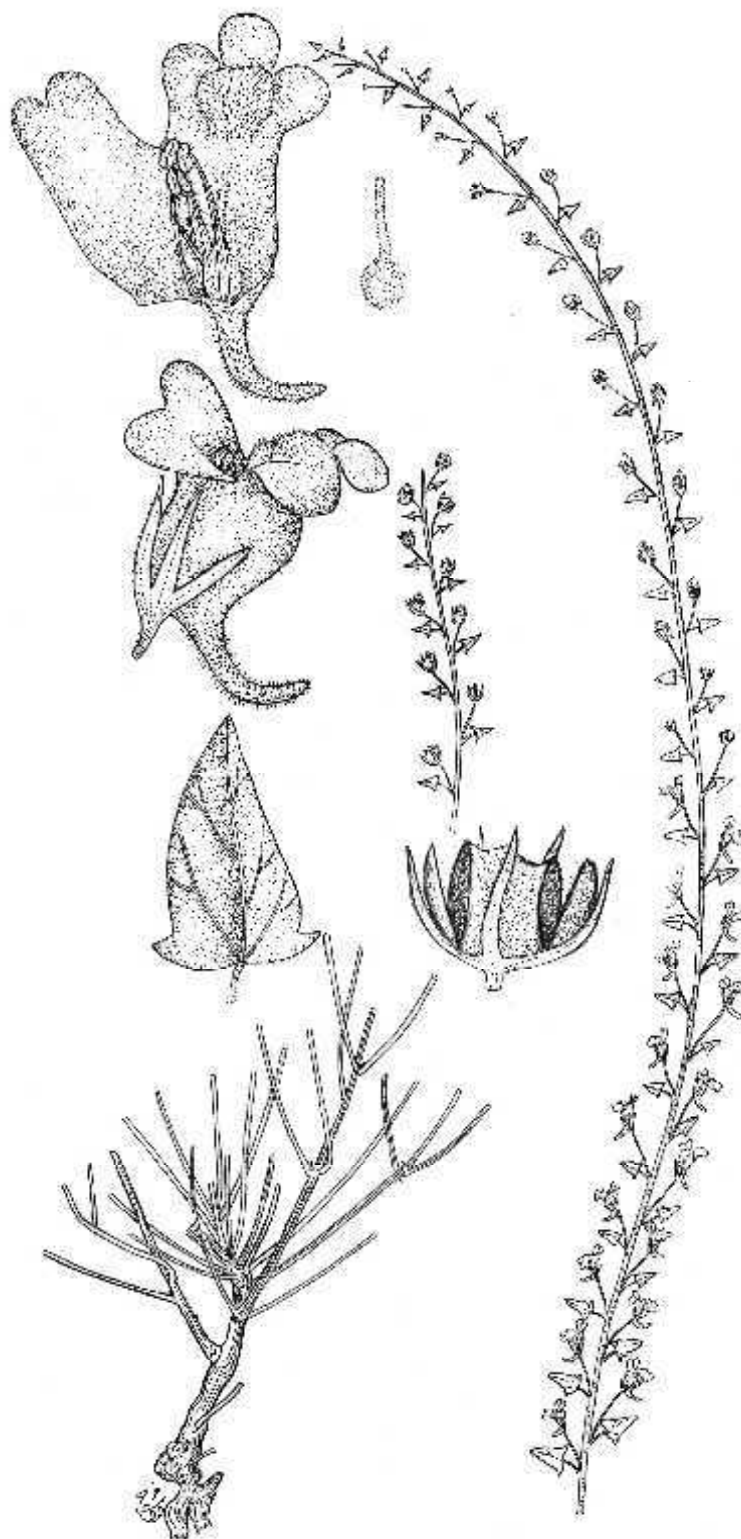


Fig. 2. *Nanorrhinum baluchistanicum* ($\times 0.6$); details ($\times 6$).

Table 1. Morphological comparison of *Nanorrhinum baluchestanicum* with its relative in the genus *Nanorrhinum* and also some other *Kickxia* taxa still not transferred to *Nanorrhinum*.

Characters	<i>N. campyloceras</i>	<i>N. baluchestanicum</i>	<i>K. ovata</i>	<i>K. caubulica</i>
Stem (cm)	41-75	40-70	15-35	25-45
Leaf shape	Basal leaves linear or linear-lanceolate, acute, rounded or sagittate at base, upper leaves linear acuminate	Basal leaves ovate-dentate acute, subcordate, upper leaves ovate, sagittate, acute	Basal leaves ovate to elliptic, obtuse, serrate or entire, rounded at base, falling, upper leaves lanceolate to broadly ovate or rhomboid, at base truncate hastate, or rounded	Basal leaves ovate to elliptic, obtuse, serrate or entire, rounded at base, upper leaves lanceolate, ovate or deltoid, acute to obtuse, entire, at the base truncate, rounded, hastate or sagittate
Petiole (mm)	5-8	5-7	6-11	4-9
Pedicel (mm)	2-8 in flower and 5.5-10 in fruit, recurved distal end, glabrous	10-20, curved below, glabrous	12-21, filiform, straight except for distal end	11-17, erect-patent, filiform, somewhat curved, except for distal end
Calyx shape and indumentum	Lanceolate-subulate, glabrous	Linear-lanceolate, glabrous or with glandular and eglandular hairs	Linear-lanceolate, glandular-pubescent	Linear-lanceolate or lanceolate
Corolla (mm) and color	9.5-13, pink, brownish yellow	4.5-10.5, yellow	8-10, yellow	8-11, yellow
Adaxial sinus, abaxial sinus (mm)	Adaxial sinus 0.8-1.2, abaxial sinus 1.8-3	Adaxial sinus 1.2-1.5, abaxial sinus 1.5-2	Adaxial sinus 1-1.2, abaxial sinus 1.5-1.8	Adaxial sinus 0.6-1, abaxial sinus 1-1.4
Internal and external indumentum of corolla	Eglandular-pubescent externally, pubescent internally	pubescent externally and internally	Glandular-pubescent or subglabrous externally, glandular-pubescent internally	Glandular-pilose externally, pilose internally
Shape of spur	Slender, acute forming obtuse angle with tube	Conical, acute	Curved or more or less straight, acute	Curved, acute
Spur (mm)	3-5	3.5-4	4-5	4.5-6.5
Width of the corolla	2-3	2-3	2.5-3	2.3-2.8
Abaxial filament	pubescent	pubescent	pubescent	subvillous
Capsule shape	Ovoid truncate, mucronate, with beak, glabrous	Globose, locules unequal, glandular	Oblong-ovoid, glabrous, locules equal	Locules equal, oblong-ovoid
Seed shape	Elliptic	Elliptic	Oblong-ellipsoid	Oblong-ovoid to oblong-ellipsoid
Seed color	Bright brown	Blackish-brown	Blackish-brown	Blackish-brown
Seed ornamentation	Tuberculate, glochidate	Tuberculate, glochidate	Tuberculate, tubercles columnar	Tuberculate, tubercles columnar

3. Plant glabrous or with scattered glandulose hairs on petioles. Leaf blades up to 11 mm long and 7 mm broad

3. *N. baluchestanicum*

- Plant thoroughly glandular hairy. Leaf blades larger, up to 15 mm long and 12 mm broad

2. *N. khuzestanicum*

1. *N. baluchestanicum* Naanaie, Assadi & Tavassoli, **sp. nov.**

-Fig.1 (D-E); Fig. 2.

Perennis, suffrutescens. Caulis 40-70 cm altus, erectus vel procumbens, gracilis, a basi divisus, glaber vel interdum pubescens, implexus. Folia heteromorpha; folia basalia ovata, dentata, acuta, subcordata, 5-15 mm

Table 2. Morphological comparison of *Nanorrhinum khuzestanicum* with its relative in the genus *Nanorrhinum* and also some other *Kickxia* taxa still not transferred to *Nanorrhinum*.

Characters	<i>N. chasmophyticum</i> .	<i>N. khuzestanicum</i>	<i>K. incanus</i>	<i>N. elegans</i>
Stem (cm)	5-8.5	14-55	15-35	5-35 (-85)
Leaf shape	Elliptic-ovate or cordate-orbicular or deltoid-orbicular, rounded or cordate at base	Ovate, sagittate, hastate or cordate	Ovate or oblong-ovate, rounded or hastate at base, obtuse or subacute, with a few teeth near base	Ovate to cordate-orbicular, subacute to obtuse, often mucronate, cuneate, truncate, cordate or hastate-sagittate at base
Petiole (mm)	1-2	3-7	0.5-3	1-5 (-11)
Pedicel (mm)	2-5	15-7	7-17	(4-)6-11
Corolla (mm)	9-11	8-13	6-8	5-7.5
Internal and external indumentum of corolla	Glandular-pubescent externally and internally	Glandular-pubescent externally and internally	Eglandular-pubescent externally, palate sparsely villous internally	Densely covered with patent, eglandular hairs externally, palate subglabrous
Shape of spur	Slender, more or less straight, acute forming an obtuse angle with the tube	Conical, acute forming obtuse or right angle with the tube, shorter than the rest of corolla	Somewhat curved, acute forming an obtuse angle with tube, slender, straight	Patent, slender, strongly curved forward, shorter than rest of corolla
Spur (mm)	2.5-3	3-4	2-3	2-3
Width of the corolla	3-5	1.5-1.8	1.5-2.5	1-1.5
Abaxial filament	Sparsely pilose	Pubescent	Sparsely villous	Subglabrous
Capsule shape	Oblong-ellipsoid, mucronate-tuberculate	Globose with equal lobes	Subglobose, obtuse, subglabrous or sparsely glandular pilose at apex	Oblong-ovoid
Seed shape	Oblong-ellipsoid	Conical to elliptic papillate	Oblong-ovoid to oblong-ellipsoid	Oblong-ovoid, obliquely truncate
Color seed	Brown	Brown or olive	Dark brown	Dark brown
Seed ornamentation	Tuberculate, papillate, tubercle glochidate	Tuberculate, tubercle conical, obtuse	Tuberculate, tubercles columnar, obtuse, papillate or rarely subglabrous	Tubercles conical, often laterally compressed

longa, 2-7 mm lata, glanduloso-pilosa, petiolata; petioli 5-7 mm longi; folia superiora ovata, sagittata, acuta, 5-6 mm longa, 2.5-4 mm lata; petiolis 4 mm longis. Inflorescentia laxa racemosa. Flores singules, pedicellati; pedicelli patentes, infra calycem curvati, glabri, 10-20 mm longi. Calycis lobi linearo-lanceolati, acuminati, ad margines anguste scariosi, glabri vel pilis simplicibus et glandulosis praediti, 3-4 mm longi, 0.5-1 mm lati. Corolla 4.5-10.5 mm longa, flava; calcar conicum, acutum, 3.5-4 mm longum; tubus 2-3 mm latus; lobus adaxialis 3 mm longus, sinu 1.2-1.5 mm longo; lobus abaxialis 3.5-4.5 mm longus, sinu 1.5-2

mm longo. Filum abaxiale pubescens vel lanatum. Capsula globosa, 3 mm longa, 2.6-3 mm lata; loculi unaequales. Semina elliptica, atrobrunnea, 0.2-0.5 mm longa, 0.2-0.3 mm lata, tuberculata, apice papillis recurvatis.

Typus. Baluchestan: Between Chah Bahar and Pasa Bandar, 50 m, 13.12.1991, Mozaffarian & Ghahreman 14004 (holotypus TARI).

Other specimens seen. Chah Bahar, Between Pasa Bandar and Goater, 10 m, 14.11.1984, Mozaffarian 52845; Between Chah Bahar and Pasa Bandar, 20 m, Mozaffarian 58749

Perennial *suffrutescent*. Stem 40-70 cm long, erect or procumbent, slender, divided from the base, glabrous or sometimes pubescent, with interwoven branches. Leaves heteromorphic; basal leaves ovate, dentate, acute, subcordate at the base, 5-15 mm long, 2-7 mm broad, with glandular hairs, petiolate; petiole 5-7 mm long, with glandular hairs; upper leaves ovate, sagittate, acute, 5-6 mm long and 2.5-4 mm wide; petiole 4 mm long. Inflorescence loose raceme. Flowers single, pedicellate; pedicel patent, curved below the calyx, glabrous, 10-20 mm long. Calyx lobes linear-lanceolate, acuminate with narrow scarious margin, glabrous or with glandular and eglandular hairs, 3-4 mm long and 0.5-1 mm broad. Corolla 4.5-10.5 mm long, yellow; spur conical, acute, 3.5-4 mm long; width of tube 2-3 mm; adaxial lobe 3 mm long; adaxial sinus 1.2-1.5 mm; abaxial lobe 3.5-4.5 mm long; abaxial sinus 1.5-2 mm. Corolla pubescent externally; palate pubescent. Abaxial filament pubescent to lanate. Capsule globose; locules unequal, 3 mm long and 2.6-3 mm broad, glandular. Seeds elliptic, blackish brown, 0.2-0.5 mm long and 0.2-0.3 mm broad, with narrowly columnar tubercles and recurved papilla at apex.

This species is a close relative of *N. campyloceras*. It differs from *N. campyloceras* in corolla colour, leaves shape, length of pedicel, adaxial and abaxial sinus, calyx and palate indumentum, externally corolla indumentum capsule shape and indumentum and unequal loculi, spur angle to tube and flowering time. (Table 1)

2. *N. khuzestanicum* Naanaie, Assadi & Tavassoli, *sp. nov.*

-Fig. 1 (A-B); Fig. 3.

Perennis, *suffrutescens*. Caulis 14-55 cm longus, prostratus, decumbens, basim divisus, pilis glandulosis 0.4-1 mm longis, pilis eglandulosis 1-2 mm longis. Folia homomorpha, ovata, sagittata, hastata, cordata, acuminata, 3-15 mm longa, 2-12 mm lata, petiolata; petioli 3-7 mm longi, pilis glandulosis 0.6-1 mm longis, pilis eglandulosis 0.6-2 mm longis. Inflorescentia racemosa. Flos singulis. Pedicellus patens, filiformis, 7-15 mm longus. Calycis lobi lineari-lanceolati, acuminati, marginibus scariosis, 3-5 mm longi, 0.7-1 mm lati, villosi, pilis 1-2 mm longis, pilis glandulosis 0.5-1.5 mm longis. Corolla 8-13 mm longa, flava sed palatum et calcar violaceum; calcar conicum, acutum, 3-4 mm longum, 0.5-1 mm latum; tubus ad orem 1.5-1.8 mm latus; lobus adaxialis 2-3.5 mm longus, sinu 1.2-2 mm longo; lobus abaxialis 3.5-5 mm longus, sinu 1.5-2.5 mm longo. Antherae glabrae; filis abaxialis pubescens. Capsula globosa, loculis aequalibus, 2-3 mm longa, 3 mm lata, valvate dehiscentia, pilis

glandulosis; semina numerosa, conica vel elliptica, tuberculata, 0.3-0.4 mm diam.

Typus: Khuzestan: Masjed Soleyman, Andika, Monar mountain, 1650 m, rocky and stony slopes, 26.11.1985, Mozaffarian, 74607 (holotypus TARI).

Other specimen seens. Lorestan: Aligudarz, Baznavid, between Gardaneh Ghallesh to Baznavid, 1550 m, Mozaffarian 77224.-Bakhteyari: Lordegan, north of Lalehgan village, 2180 m, Gholameian 1851; Bard bozorg, Goharnaz, 1965 m, Gholameian 91; Felard, 1965 m, Ghaedi & Gholameian 51420.- Fars: 34 km Noorabad to Dogonbadan, 700 m, Assadi & Abohamzeh 38487; Shiraz, Tanag-e Bolhayat, on the road to Kazeroon, 1120 m, Foroughi 17402. Khuzestan: Izeh, Dehdez, pole Salou, over Karoon river, 750 m, Mozaffarian 53634; Izeh, eastern Susan, 850 m, Naanaie & Mohamadi 6285; 20 km south of Izeh, 850 m, Mozaffarian 720215; Baghmalek; Saraseyab village, 100 m, Naanaie & Mohamadi 6554; Andimeshk to Khoram abad, Ghilab village, pole Mongereh, 700 m, Naanaie & Mohamadi 6215.

Perennial *suffrutescent*. Stem 14-55 cm high, prostrate, decumbent, divided from the base, with glandular hairs 0.4-1 mm long and eglandular hairs 1-2 mm long. Leaves homomorphous, ovate, sagittate, hastate, cordate, acuminate, 3-15 mm long and 2-12 mm broad, petiolate; petioles 3-7 mm long, with glandular hairs 0.6-1 mm long; long hairs up to 0.6-2 mm long. Inflorescence raceme. Flowers single. Pedicel patent or bent downwards below, filiform, up to 7-15 mm long. Calyx lobes linear-lanceolate, acuminate, with scarious margin, 3-5 mm long, 0.7-1 mm wide, villous; hairs up to 1-2 mm long; glandular hairs up to 0.5 to 1.5 mm. Corolla 8-13 mm long, yellow; palate and spur violet; spur conical, acute, forming obtuse or right angle to the tube, 3-4 mm long and 0.5-1 mm broad; tube 1.5-1.8 mm wide at mouth; adaxial lobe 2-3.5 mm long; adaxial sinus 1.2-2 mm long; abaxial lobe 3.5-5 mm long, abaxial sinus 1.5-2.5 mm long, with glandular hairs up to 0.5-1 mm long externally and on palate. Anthers glabrous; abaxial filament pubescent. Capsule globose with equal locules, many seeded, 2-3 mm long and 3 mm wide, with glandular hairs, valvately dehiscent. Seeds conical to elliptic, tuberculate, 0.3-0.4 mm in diam.

This species is a close relative of *N. chasmophyticum*, *N. elegans* and *K. incanus*. It differs from *N. chasmophyticum* in leaves shape, length of stem, petiole and width of the corolla tube, capsule shape and morphology, color and ornamentation of seeds (Table 2).

3. *N. campyloceras* (Rech. f. & Esfand in Rech. f.) Naanaie, Assadi & Tavassoli, *comb. nov.*



Fig. 3. *Nanorrhinum khuzistanicum* ($\times 0.8$); fruiting calyx and flower ($\times 9$); corolla ($\times 12$); ovary ($\times 5$).

Syn: *Linaria campyloceras* Rech. f. & Esfand in Rech. f., Anz. Osterr. Akad. Wiss, Math. Nat. 87: 90 (1950); *Kickxia campyloceras* (Rech. f. & Esfand.) Speta, Pl. Syst. Evol. 132: 4 (1979); *Nanorrhinum campyloceras* (Aellen & Esfand.) Podlech & Iranshahr in Ghahreman Fl. Iran 25: no. 3082 (2005), nom. inval.

-Fig.1 (F-G)

Perennial or shrub, suffrutescent. Stem up to 41-75 cm high, divided from the base, divaricate, glabrous or pubescent, with the hairs at the base 0.2-0.3 mm long. Leaves hetromorphus, entire; basal leaves linear or linear-lanceolate, acute, rounded or sagittate at the base, 8-20 mm long 1-5 mm broad; petiole 5-8 mm long, with short glandular hairs; upper leaves linear, acuminate attenuate at base, 5-25 mm long and 1-7 mm broad; petiole 5-8 mm long with glandular hairs. Bracts leaf-shape, linear, acute, 1.5-7 mm long, 0.6-1 mm broad, entire. Inflorescence loose raceme. Flowers single; pedicel 2-8 mm in flower, and 5.5-10 mm in fruit, recurved distal end, glabrous. Calyx lobes lanceolate subulate, acuminate, with narrowly scarious margin, glabrus, connected in 1/3 length, 2.5-4 mm long and 7-1 mm broad. Corolla 9.5-13 mm long, pink or brownish yellow, eglandular-pubescent externally; eglandular hairs up to 0.3-1 mm long; corolla tube 2-3 mm long; tube at mouth 2-3 mm broad; adaxial lobe 3.8-5 mm long; adaxial sinus 0.8-1.2 mm; abaxial lobe 5-7 mm long; abaxial sinus 1.8-3 mm long; palate plicate, pubescent; spur 3-5 mm long and 0.75-1.5 mm broad, slender, acute or forming obtuse angle with the tube, shorter than rest of corolla, abaxial filament pubescent. Capsule ovoid, truncate, 2.2-3 mm in diam., mucronate with beak 1.5-2 mm long, glabrous, sometime at the apex with eglandular hairs; locules subeqaul; adaxial locule dehiscent before abaxial locule, many seeded, elliptic, glochidate; glochids bright brown, 0.5-0.9 mm long and 0.3-0.5 mm broad.

Specimens seen. Fars: 19 km from Khonj to Lar, 700-1200 m, Assadi & Sardabi 41640. -Bushir: Bushir to Bandar Lengeh, 20 km SE of Taheri, 20-100 m, Bokhari & Wendelbo 1926. -Hormozgan: Bashagard, 88 km from Senderk to Angoran, SE of Jakdan 550-1200 m, Mozzaffarian 44315; Ab- e Garne Genu, 150-250 m, Mozzaffarian 58366; Bashagard, 11 km Senderk to Darpahn, after Arangeh, 450 m, Mozaffarian et al. 39185; 50 km NE of Senderk, Araghin, 1100-1600 m, Mozaffarian et al. 42542; Bashagard, 88 km from Senderk to Anguran, SE of Jakdan 44315; Bashagard, 62 km from Senderk to Anguran, close to Jakdan, 700 m, Mozaffarian et al. 39337; Ab- e Garne Genu, 200 m, Wendelbo & Foroughi 15726; Ab- e Garne Genu, 150- 250 m, Ghahreman & Mozaffarian 54400; 8 km N of Bastak, 500 m, Assadi & Sardabi 41888; Bashagard, S of Jakdan village, 1200 m, Mozaffarian et al. 39363; Bashagard, Khomeini shahr, Gar kuh, S of kuhe Hang,

1700 m, Zaefii & Khosravifar 4017; 45 km from Minab to Rudan, NE of Sarzeh, 200-900 m, Mozaffarian et al. 44191; Bashagard, 42 km from Senderk to Anguhran, between Darpahn and Davari, 750 m, Mozaffarian 39287; 15 km from diviation of Minab Rudan, 500 m, Mozaffarian et al. 39461; Bashagard, 53 km from Senderk to Anguhran, after Davari, 600 m, Mozaffarian et al 39308, 35 km from Senderk to Araghin, Deh-e Ziaratoon village, Mozaffarian 44483; 80 km from Minab to Kahnij, 300-350 m, Mozaffarian et al. 44236; Bandar abbas, Siaho, 1200 m Mozaffarian et al. 39710; Kerman: 122 km from Haji abad on the road to Esfandegan, Abdasht, 1650 m, 25282. -Fars: 8 km S of Lar, 100 m, Assadi & Sardabi 41755. -Baluchestan: Tange Sorkheh, between Iranshahr and Chah Bahar, 24.03.1949, Sharif 292 typus IRAN); 55 km from Khash to Iranshahr, 150 m, Mozaffarian 42881; 130 km from Bampur to Iranshahr, Tang-e Sarhe, 1150-1250 m, Mozaffarian 43086; Iranshahr to Bam, Bazman, Kuhe Pansareh, 25 km to Bazman. 900-1300 m, Termeh et al.; 92 km from Khash to Iranshahr, Tigh- Ab region, 1000-1100 m, Mozaffarian 42960; 20 km Suran to Sarvan, 1250-1350 m, Mozaffarian 43960; Sareh, 1000 m, Ghahraman et al 21596; Bazman, mountain, between Iranshahr and Bam, 1000 m, Assadi 23077; 85-100 km from Branched road, of Khash to Bazman, Assadi 23006; Bahooklat to Houdar, Iranshahr & Ershad 38809; Maskotan to Hitchan, 750-950 m, Esfandiari et al. 3541

4. *N. chasmophyticum* (Wendelbo) Naanaie, Assadi & Tavassoli, **comb. nov.**

Syn.: *Kickxia chasmophytica* Wendelbo, Notes Roy. Bot. Gard. Edinb. 38 (1): 109 (1980).

Fig. 1 (C); Fig. 4.

Plant perennial, forming cushion. Stems 5-8.5 cm long, divided from the base, softly villous with long, slender spreading eglandular hairs up to 1.5 mm long and shorter glandular hairs up to 0.5 mm. Leaves homomorphic broadly elliptic-ovate or cordate-orbicular, rarely deltoid-orbicular, entire, subacute to obtuse 2-3 mm long and 2-2.9 mm broad, rounded or cordate at the base, petiolate. Inflorescence loose raceme. Flowers single. Pedicels 2-5 mm long curved below the calyx, filiform, glabrous, villous above, usually exceeding subtending leaf. Calyx lobes linear-subulate or linear-lanceolate, acuminate, narrowly scarious at the margin, 3-4 mm long and 0.5 mm broad, villous below, with hairs up to 2 mm long above. Corolla 9-14 mm long, bright yellow, with violet spur and violet marking on tube and palate; spur slender more or less straight, acute, forming an obtuse angle with the tube, shorter than the rest of corolla, 2.5-3 long

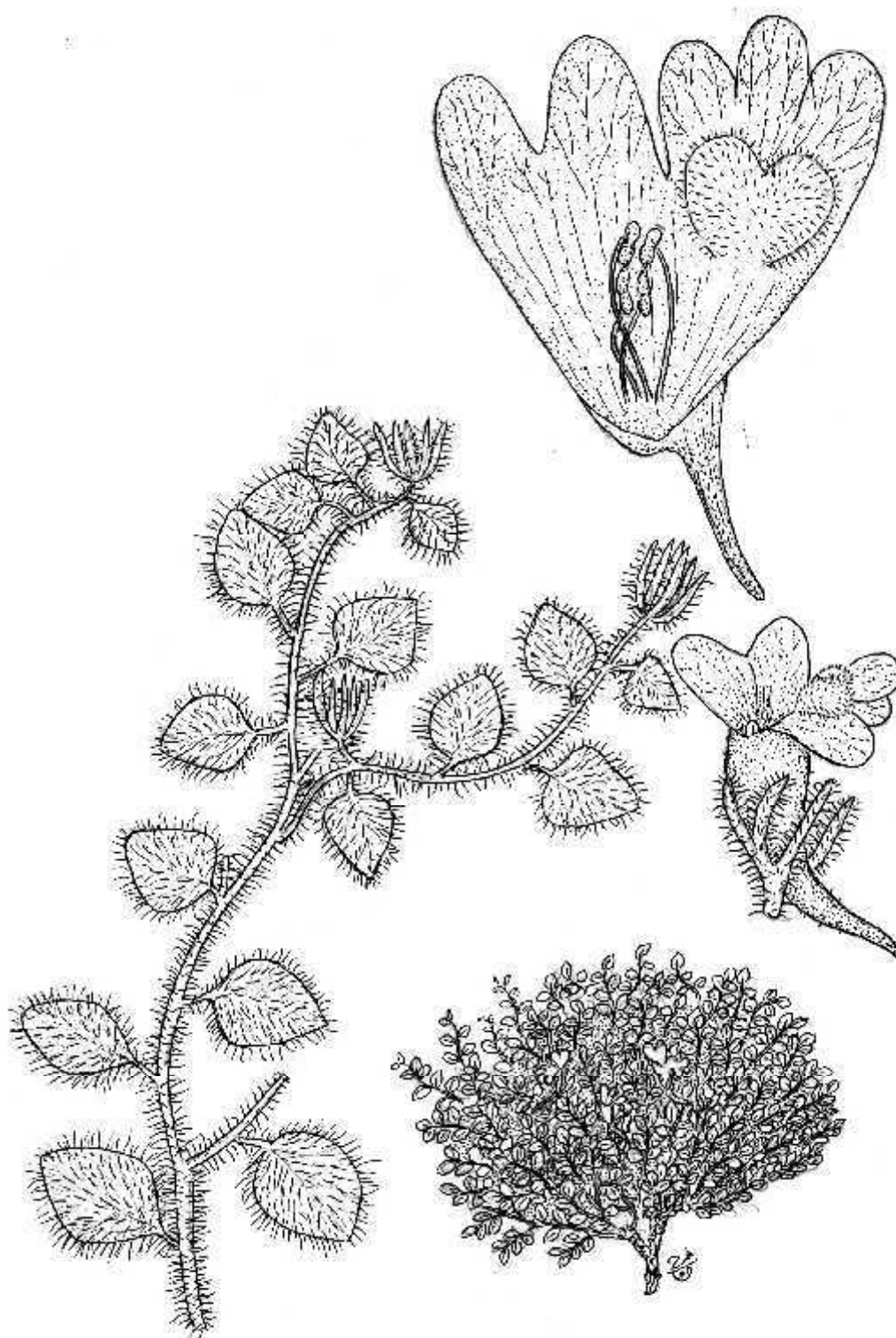


Fig 4. *Nanorrhinum chasmophiticum* ($\times 1$); branch ($\times 4$); flower ($\times 5.5$); corolla ($\times 11.5$).

and 0.5 mm broad; adaxial lobes 2-3 mm long; sinus 1.5-1.7 mm long; abaxial lobes 2.5-3 long; sinus 1.5-1.7 mm long; tube width 3-3.5 mm at the mouth, glandular pubescent externally; palate glandular-pubescent. Abaxial filaments sparsely pilose. Capsule 2.5-3 mm in diam, broadly oblong-ellipsoid, mucronate, tuberculate. Seeds brown, oblong-ellipsoid to ellipsoid, tuberculate, papillate, tubercles columnar to narrowly conical, obtuse or truncate; tubercle length $0.6-2.5 \times$ width; papillae mostly restricted to tubercle apex, more or less patens but recurved; the papilla length $1.3-2.5 \times$ width.

Specimens seen. Hormozgan: Bandar-Abbas, Kuh-e Genu, top region, 2200-2300 m, Wendelbo & Foroughi 15400 (isotypus TARI).; Badar abbas, top region of Kuhe Genu, 2250 m, Foroughi 16084.

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