Summery:- employment, provides a chief source of

Science, Agriculture

Summery:-Organogenesis andphysical embryogenesis area unit the 2 pathways of selection for fast andall-encompassing propagation of Phoenix dactylifera.

These pathways completelyused for the micropropagation of best genotypes and have verified theirimportance for the industrial production of plenty of cultivars. However regeneration through physical embryogenesisand organogenesis in Phoenix dactylifera continues to be troublesome to attainfor recalcitrant genotypes and is commonly during a weak position by surephysiological disorders. During this review, we tend to report the results of atotal of studies applied on Phoenix dactylifera micropropagation. It statesthat regarding various factors that influence every stage of physicalembryogenesis and organogenesis. Keywords:- Phoenix dactylifera L.; Organogenesis; Somatic embryogenesis Introduction:- Date palm (Phoenix dactylifera L.)is one of the most essential fruit crops cultured in arid and semi-aridregions.

It is circulated throughout the Middle East, North Africa, SouthSahel, areas of East and South Africa, Europe and USA (Mazri et al ., 2015), with approximately 150 million trees worldwide (Mazri et al ., 2015). Date palmis refined for its high yield and the high nutrient value of its fruit, forpreserving ecosystems threatened by desertification and creating suitablemicroclimate for agriculture under arid surroundings. In addition, date palmcultivation generates considerable chances for rural employment, provides a chiefsource of income for farmers and confirms livelihood and food security of therural areas (Mazri et al .

, 2015). Date palm can be proliferated sexually byseeds or asexually by offshoots. Propagation by seeds cannot be used for the commercialproduction of best genotypes due to its heterozygous character (Tisserat, B.

1982), and because of theconsiderable difference between seedlings and vegetatively propagated plants inexpressions of production potential, fruit maturation and value, and harvestingtime . Propagation by offshoots is a slow procedure that is hampered by the limitednumber of offshoots produced by a single date palm tree, the low survival rateand the risk of transferring diseases. Propagation of date palm concluded invitro techniques presents an competent alternative for the conventional methods. Indeed, date palm micropropagation allows fast andlarge-scale proliferation of uniform and healthy plants, with neither seasonaleffects nor the risk of distribution diseases and pests during plant materialexchange (Quiroz-Figueroa et al ., 2006)Aim of this review is to summarize the literature on date palm micropropagation through somatic embryogenesis andorganogenesis, and highlight the main factors affecting each stage of these twomicropropagation techniques. Beside this, the main problems come across duringdate palm micropropagation are described. Date Palm Propagation Methods:- Available techniques of rapid multiplication of date palm havecontributed hugely increased demand of date palm fruits worldwide (Jain et al.

, 2011). Traditionally, date palm is proliferated by both sexually through seedsand vegetatively by off shoots that produced from axillary buds located

on thebase of the trunk during the juvenile phase in date palm tree. It is very slowfor off shoots to progress and that hampers vegetative propagation of date palmplant.

So far, there is no obtainable technique to speed up in increasing theoff shoot quantities as well as reduce the time in developing them. Use of offshoots preserve true-to-type character of reproduced genotypes. Moreover, sexual propagation of date palm is unsuitable for commercial production oftrue-to-type value-added genotypes. It is due to heterozygous character of datepalm seedlings and also their dioecious nature (Jain, 2007a). In addition, halfof this progeny is collected of male trees which not distinguished beforeflowering stage. The female plants produce variable fruits and commonly ofinferior quality (Eke et al., 2005).

Additionally, seed propagation method hasanother drawback that the growth and maturation of seedlings is extremely low, and this is a reason, date palm seedling may begin to fruit after 8-10 years ofplantation. Though offshoot propagation is a true-to-type technique, it is notcommercially practical for the following causes: Offshoot production is restrictedto a relatively short vegetative phase of about 10 to 15 years; Only a limited number of offshoots are formed during this phase (20 to 30 offshoots, depending on variety); Some varieties harvest more offshoots than others (some do not produceoffshoots at all); Offshoot survival ratio is low; The use of offshoots improves the spread of date palm diseases and pests; Offshoot propagation is difficult, lengthy, and therefore expensive. In vitro propagation of date palm:- Use of in vitro techniques

such as somaticembryogenesis and organogenesis is highly proper for large-scale plantmultiplication of vegetatively proliferated crops. Success of these techniquesis highly genotypic dependent, though, have successfully been practical forplant propagation in wide ranging crops including date palm (Jain, 2007a). Micropropagation by direct organogenesis is commonly used for rapid clonalpropagation of best genetic material of date palm plant (Khierallah and Bader, 2007).

Performance of micropropagated date palm appears to be better thanconventionally grown plants in terms of harvest, early flowering time, and relativelyuniform in fruit value and physical properties. Aaouine reported plant redevelopmentfrom 30 genotypes of date palm by direct shoot organogenesis. The major concernwith this method is somaclonal variation that is dependent on different factorsincluding genotype, explants, plant growth regulators (Jain, 2007a). Moreover, it is highly necessary to maintain genetic fidelity of regenerated plants, which can be studied by many molecular markers Micropropagation has a benefitof using low concentrations of plant growth regulators, as a result callusphase is avoided. Direct regeneration of vegetative buds reduces the risk ofsomaclonal variation among regenerants. Duration of culture period is limitedby numerous subcultures for maintaining and given that shoot cultures forplantlet production.

However, the highest number of subcultures must be determinedbefore starting the fresh cultures from the mother plants. This is done toprevent or reduce somaclonal variation. Currently, only a few laboratories use this

technique to producecommercially in vitro date palm plants, mainly in Morocco, Saudi Arabia andUnited Arab Emirates. Micropropagation technique has been used commerciallyin selected date palm cultivars described advantages andlimitations of date palmmicropropagation; major advantages are year round availability of plants, quality control, rapid production of plants of elite cultivars, and coldstorage of elite genetic material. Advantages and disadvantages of somaticembryogenesis (Jain, 2007b)Advantages of somatic embryogenesis:-Somatic embryos originatefrom a single cell and minimize or eliminate chimera depending on the plantspecies.

Somatic embryo cellsuspension is ideal for mutation induction due to production of direct mutantsomatic embryos. Somatic embryos behave like a zygotic embryoin germination. Single somatic embryo can be encapsulated todevelop into a somatic seed that could germinate like a normal seed. Thisaspect still requires further research for use at a commercial scale. Most suitable approach inwoody species for plant regeneration. Somatic embryos can be produced in abioreactor which could be automated for largescale production of somaticembryos. Somatic embryos aresuitable for long term storage by cryopreservation Disadvantages of somatic embryogenesis:-Somatic embryogenesis ishighly genotypic dependent and therefore culture medium modification may beneeded for different genotype.

Germination rate ofsomatic embryos is very poor in most of the crops. Somatic embryogeniccultures can lose their property if they are not sub-cultured regularly on thefresh culture medium, and that raises the chance of

getting geneticvariability. Organogenesis of Date Palm Explant selection:- The choiceof an explant and its disinfection process can affect the success ofmicropropagation including the date palm.

Shoot tips and adventitious shoots inlateral buds contain more meristematic tissues than other organs, and thereforeare frequently used in date palm tissue cultures (Mazri and Meziani, 2015). Asuccessful regeneration of many date palm genotypes has been achieved whenshoot tips were used as explants: “ Jihel” and “ Iklane”, “ Mordarsing” and” Khanizi” , “ Nabout” and “ Khasab” (Al-Khayri, 2007), and “ Khalasah”, “ Zardai”,” Barhee”, “ Zart”, “ Muzati” and “ Shishi”. Date palm tissue culturing can also beachieved by using explants derived from inflorescences, as was reported for” Barhee” and “ Gulistan”. Reynolds and Murashige (1979) induced somaticembryogenesis from zygotic embryos obtained from green fruits that wereharvested 2-3 months after pollination. Pinker also used zygotic embryos toinduce somatic embryo genesis in “ Khistawi”, “ Zahdi”, “ Barban”, “ Asabe” and” Elarous”. Somatic embryos are useful for the micropropagation and large-scaleproduction of date palm plants and may also be used to obtain true-to-typegenotypes. Explant disinfection and preparation:- The main disinfecting agent that has been used for shoot tips is sodiumhypochlorite (NaOCl) at a concentration range from 5% to 25% and for spikelets, mercuric chloride (HgCl2) at 0. 1% concentration.

In addition, the use ofantioxidants such as 150 mg/l ascorbic acid (for 30 min), 4%polyvinylpyrrolidone (Aslam and Khan, 2009), citric acid at a

concentration of150 mg/l with 150 mg/l ascorbic acid (soaked overnight), or anhydrous caffeineare widely used during shoot tip explant disinfection (Khierallah et al., 2007). Khan and Tabassum (2012) used an effective protocol to eliminate infection fromshoot tips: treatment with 5% (w/v) NaOCl containing one drop of a surfactant(Tween-20/100 ml), stirred gently for 30 min, rinsed three times in steriledistilled water (SDW; 5 min each rinse), surface disinfested with 0.

2% (w/v)HgCl2 for 10 min and then rinsed three times with SDW. Leaf primordia of 6 cmlong shoot tips were removed and used as explants and 2 cm long shoot tips with2-4 intact primordial leaves also served as explants. A similar protocol has beenused by Othmani for leaves adjacent to the apex of axillary shoots of cv.” Boufeggous”. Fki first washed young leaves with tap water, and surfacesterilized them with 0. 01% HgCl2 for 1 h, rinsed three times with SDW, then cutthem into 5-10, 10-15 and 15-20 mm long explants. Ledo described a disinfectionprocedure for zygotic embryos from mature (wine-colored, -2.

17 g) and immature(green, -1. 68 g) fruits from “ açai” palm, an Euterpe species of palm treecultivated for its fruit. After being washed under running tap water, fruitswere immersed in 40EC water, and seeds were excised on a laminar flow bench, immersed in 70% ethanol for 2 min, then in 2% NaOCl for 20 min under agitation, and finally washed four times with SDW (Khokhar, M. I. et al .

, 2017). Adventitious bud initiation:- The formation of adventitious buds on date palm explants depends on

manyfactors such as media components, genotype, and time period of plant materialcollection. Various culture media were suggested for adventitious budformation, depending on the cultivar. From offshoot-derived explants, Beauchesne et al.

suggested half-strength Murashige and Skoog (MS) mediumsupplemented with 1-5 mg/L 2-naphthoxyacetic acid (NOA), 1 mg/L NAA, 1 mg/Lindole-3acetic acid (IAA) and 0. 1-3 mg/L 6-(dimethylallylamino) purine (2iP). Khierallah and Bader recommended MS medium supplemented with 2 mg/L 2ip, 1 mg/LBAP, 1 mg/L NAA and 1 mg/L NOA for cv. Maktoom. Al-Mayahi suggested MS mediumsupplemented with 1 mg/L BAP and 0.

5 mg/L thidiazuron (TDZ) for cv. Hillawi. For cv. Zaghlool, Bekheet used MS medium supplemented with 2 mg/L 2ipand 1 mg/L NAA while Hussain et al.

used MS medium supplemented with 4 mg/L IBAand 1 mg/L BAP for cvs. Asil, Hussaini and Zaidi. According to Al-Khateeb, lowPGRs concentrations promote the formation of buds while high concentrationsinduce abnormal growth without bud formation. Studies on adventitious budformation from inflorescence explants are very scarce. Loutfi and chlyahindicated that shoot primordia is formed mostly on Greshoff and Doy mediumsupplemented with 0. 5 mg/L NAA, 2 mg/L BAP and 1 mg/L 2iP. In a recent reviewof the literature, Abahmane reported that the combination of one auxin and twocytokinins is effective for bud formation on inflorescence explants.

As regardto the period of offshoot removal, Beauchesne et al. suggested a periodstarting from the end of dates harvesting and lasting until the

beginning offlowering. Aissam reported that the explants taken between October and Februaryshow the highest buds formation rate, whereas Zaid et al. reported that thebest period for the in vitro culturing of offshoot-derived explants is from theonset of flowering . Shoot bud multiplication Many factors influence shoot budmultiplication in date palm, especially the basal formulation of the culturemedium, the genotype and PGRs.

Abahmane mentioned that the main basalformulation used is MS at full or half-strength, supplemented with PGRs at lowconcentrations as compared with the bud initiation stage. Zaid et al. reportedthat for shoot bud multiplication, NAA, NOA, IAA, BAP and kinetin might be usedat 0. 5-5 mg/L. Beauchesne et al. suggested half-strength MS medium supplementedwith 2 mg/L NOA, 1 mg/L NAA, 1 mg/L IAA, 0.

5 mg/L BAP, 1 mg/L 2iP and 1-5 mg/Lkinetin. For cultivar Khalas, Aslam and Khan used 7. 84 µM BAP for high shootbud multiplication. Khierallah and Bader recommended MS medium with acombination of 1 mg/L NAA, 1 mg/L NOA, 4 mg/L 2iP and 2 mg/L BAP for date palmcv. Maktoom while Khan and Bi Bi found that MS medium containing 0.

5 mg/L BAPand 0. 5 mg/L kinetin yields the highest number of shoots per explant in cv. Dhakki. In a previous work on cv. Najda, we found that the best medium forshoot bud multiplication was half-strength MS medium supplemented with 0. 5 mg/LNOA and 0. 5 mg/L kinetin, which yielded an average of 23. 5 shoot bud perexplant after 3 months of multiplication.

Mazri recommended MS mediumcontaining 2. 5 ? M IBA and 2. 5 ? M BAP for cv. 16-bis (22. 3 shoot buds per explant)while he recommended half-strength MS medium supplemented with 3 ? M IBA and 3? M BAP for cv. Boufeggous, which showed 22. 9 shoot buds per explant.

Al-Mayahisuggested MS medium containing 1 mg/L BAP and 0. 5 mg/L TDZ for cv. Hillawi, which resulted in an average of 18. 2 buds per culture.

Other factorssuch as the medium texture, cultivation in bioreactors, explant size anddensity and carbon source were also reported to affect shoot bud multiplicationof date palm. Shoot elongation, rooting and plantletacclimatization:-

Shoot elongation and rooting may be achieved either on a mediumcontaining PGRs or on a PGR-free medium. Beauchesne et al.

suggested the use ofhalf-strength MS medium supplemented with 1 mg/L NAA, 0. 5 mg/L BAP, 0. 5 mg/Lkinetin and 1-3 mg/L gibberellin for shoot elongation. El Sharabasy et al. reported that the use of 0. 1 mg/L NAA has a better effect on shoot elongationas compared to IBA and IAA. The use of liquid medium was also reported topromote shoot elongation.

As regard to shoot rooting, Bekheet recommended 1mg/L NAA, which showed better results than IAA or IBA at the sameconcentration. In a previous work on cv. Najda, we compared media with andwithout PGRs. Our results showed that shoot elongation is fast in mediasupplemented with PGRs, with high root formation rates.

However, shootscultured on PGR-free media had wider and greener leaves, and exhibited highersurvival rates after acclimatization. This shows that plantlet acclimatizationmight be influenced by previous culture conditions. Along this line, it hasbeen shown that the texture of the elongation-rooting medium influences thesurvival rate of plantlets after ex vitro transfer. Indeed, the use of a liquidmedium just before plantlet acclimatization showed lower survival rates ascompared to a semi-solid medium. On the other hand, increasing the level ofsucrose in the elongation-rooting medium increases the survival rate ofplantlets during acclimatization. Other factors such as the nature of thesubstrate and the application of gamma aminobutyric acid were reported toinfluence plantlet acclimatization (Mazri et al .

, 2015). Conclusions and Future

Prospects:- Micropropagation of date palm either throughsomatic embryogenesis or through organogenesis was reported for many cultivars, and several factors have been revealed to influence these regeneration systems. Date palm micropropagation presents an efficient way for the large-scalepropagation of genotypes resistant to bayoud, a very dangerous disease causedby the fungus Fusarium oxysporum f. sp. albedinis, which had decimated morethan 12 million trees during the last century. Plantlets of bayoud-resistantgenotypes are used to rehabilitate palm groves ravaged by this fungus. Micropropagation also allows the large-scale propagation of cultivars of highfruit quality, in order to satisfy the high demand of farmers and consumers.

Despite the numerous works published on date palm micropropagation, research isstill needed to optimize culture conditions for the newly selected genotypesand recalcitrant cultivars, to shorten the time needed to produce plantlets, and to reduce the incidence of physiological disorders. It is also important tocarry out studies related to the application of somatic embryogenesis togenetic transformation, synthetic seeds production and cryopreservation ofembryogenic cultures